VOL. XXI, No. 4 OCTOBER 1948

THE TOOL ENGINEER

OFFICIAL PUBLICATION: AMERICAN ASTE SOCIETY OF TOOL ENGINEERS

Departments

Behind every manufactured product is the tool engineer

Many of our customers don't bother to inspect 'em

Put new thread gages to work without checking them? Some experienced gaging men might protest at the very thought.

Yet that's what's happening in hundreds of plants that regularly get their gages from Pratt & Whitney. They *know* from experience these gages will be right — this whole line of standard and special thread gages. *Right* not only because they're carefully checked by Pratt & Whitney before shipment, but right *also* because they're precision lapped to a degree of mechanical perfection impossible to achieve without Pratt & Whitney special lapping equipment.

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***Division* Niles-Bement-Pond Company**
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Pratt & Whitney

PRECISION LAPPED

Thread Gages

Standard and Special

NOW ON THE PRESS — a new P&W Thread Gage Bulletin. Write for your copy.

Cross-section of P&W Dualock Thread Ring Gage shows an *extra* feature that helps gaging accuracy: note the relief at the major diameter. This means that regardless of thread contour, there's no interference at crest or root. This is a standard feature of P&W Go and Not Go Working Ring Gages.

"THERE IS NO BETTER-PAYING INVESTMENT THAN THE RIGHT TOOLS FOR THE JOB"

The Tool Engineer

Official Publication:
American Society
of Tool Engineers

Oct., 1948

Vol. XXI, No. 4

Editorial

Tool Engineers as Missionaries

Many tool engineers may be somewhat startled to find themselves cast in the role of missionaries. Perhaps we are taking some license in the use of the word, but it seems justified when one thinks of it figuratively. A missionary may be defined as one who spreads a message or belief in an effort to better the lives of the people living in the area of activity. And isn't that exactly what tool engineers are doing when they bring to the attention of industrial management the ways and means of producing more goods at lower costs so that the manufacturer can provide his market with quality items at a price people can afford to pay? He is spreading his knowledge throughout industry to give the people a better standard of living.

As in other more conventionally recognized forms of missionary activity, there are some fields in which the need for the teachings of the tool engineers is greater than others. American tool engineering had its birth one hundred and fifty years ago in the East and sparked the growth of industrialization in the New England states. As the country's population moved westward, manufacturing industries followed to fill the needs of the people, settled and grew to supply many items to many people throughout this country and throughout the world. Tool engineers played an important part in fostering the growth of these industries.

As the American Society of Tool Engineers visits the West Coast this month for its Semi-Annual Convention, it is evident that here lies the heart of American industrial growth today. The opportunities open to West Coast chapters and their members to serve as missionaries to disseminate information and gain recognition for the profession of tool engineering are unlimited.

Society members in sections of the country where a high level of industrial development has already been reached may be slightly envious when they realize the true scope of the opportunity which lies before their western brethren. This does not mean, however, that there is no challenge left for other tool engineers. There is always room for improvement.

The West Coast situation offers more than opportunity: it is a great responsibility.

Large national companies have begun a movement of assembly plants to the Pacific shores. Common sense tells us that where assembly plants go, suppliers of parts are bound to follow. Already some suppliers have built business extensive enough that they are supplying Midwestern and Eastern manufacturers.

Census figures reveal that the population of California alone has increased something like 40 per cent in the last decade. The westward movement is continuing, creating a new market center. History is repeating itself. Just as industrial development followed the movement of population into the Middlewest years ago, it is today expanding in the West.

Tool engineers will again be leaders in this development.

This Society was founded for the sole purpose of dissemination of educational information in the field of tool engineering. The growing Western industry is filled with minds receptive to the story of the advantages tool engineering offers. It is an ideal area for our missionary efforts.

The missionary work will not end with development of the Pacific area. There exists a tremendous need of the knowledge and skill of tool engineers in all parts of the world. Many section, some war devastated, others still in the throes of conflict, are not yet ready for it. But the day will come. Tool engineering will always have new worlds to conquer.

I. F. Holland

President 1948-49

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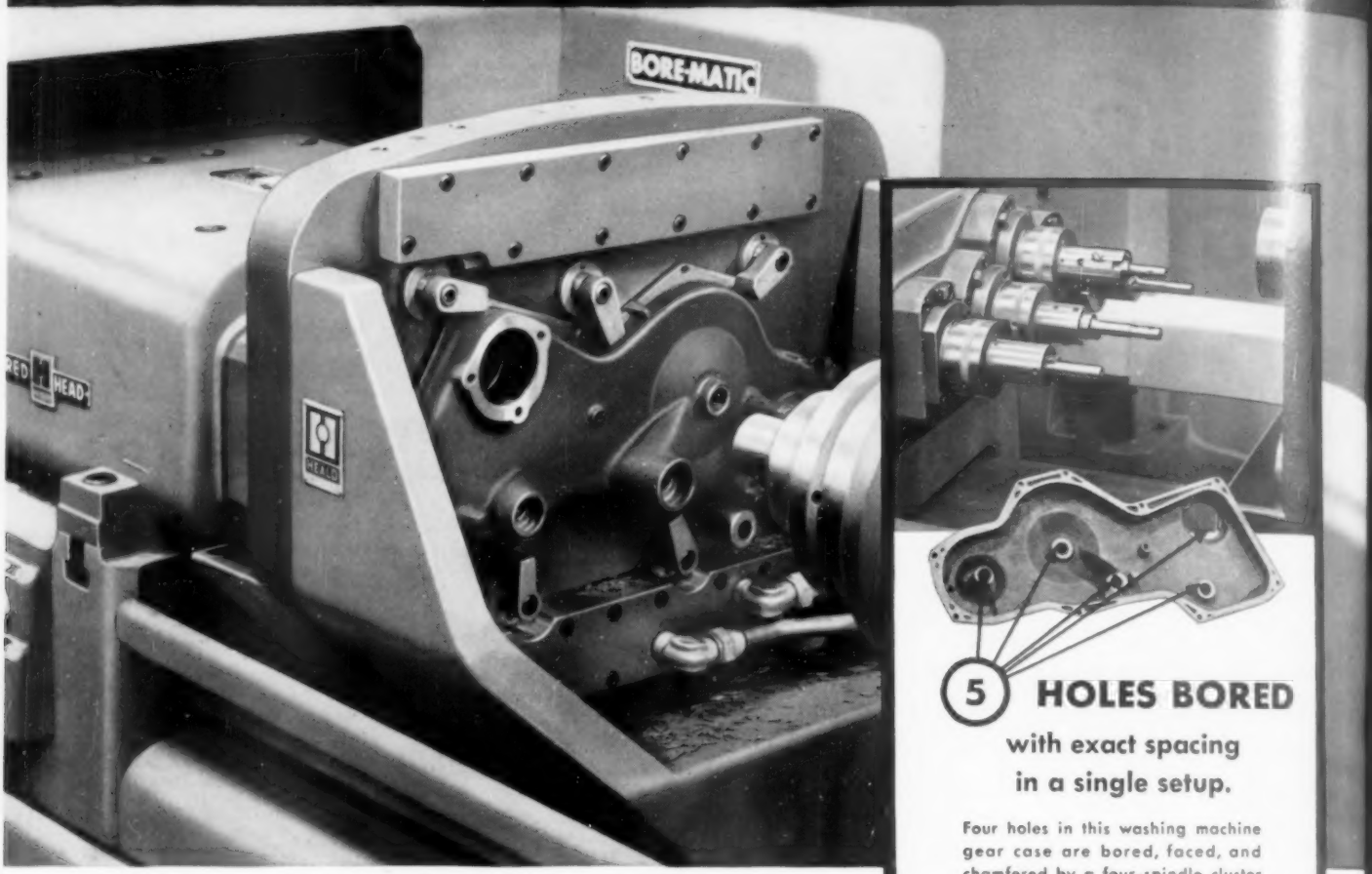

5 HOLES BORED
with exact spacing in a single setup.

Four holes in this washing machine gear case are bored, faced, and chamfered by a four-spindle cluster head on the Model 222 Bore-Matic, holding close accuracy for spacing and alignment. The fifth hole is finished by the right head.

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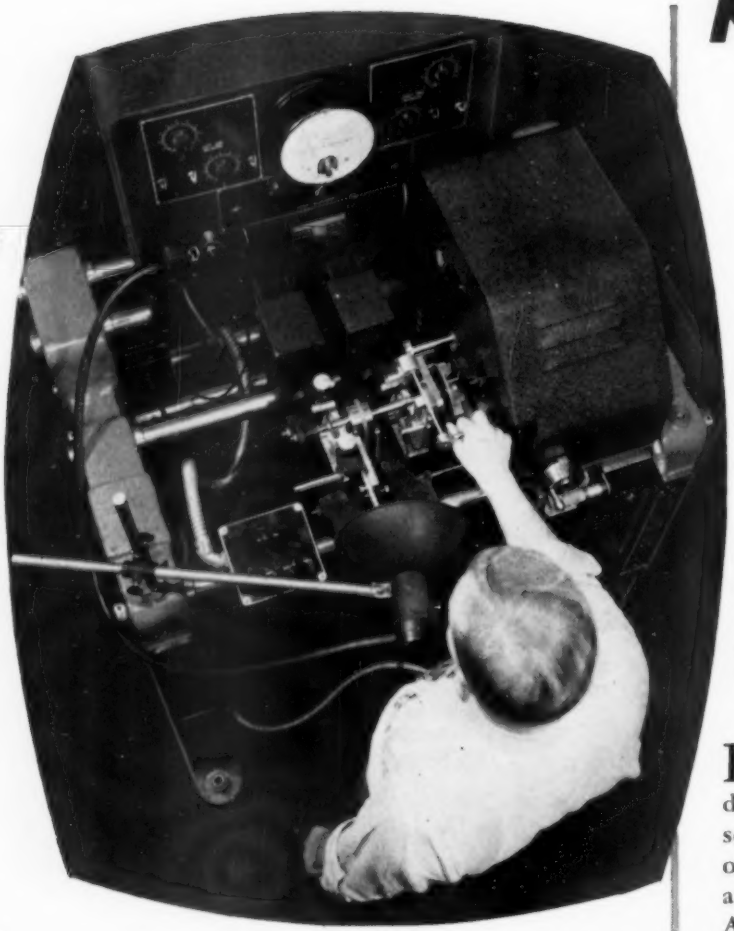

1 *Locates and measures the unbalance*

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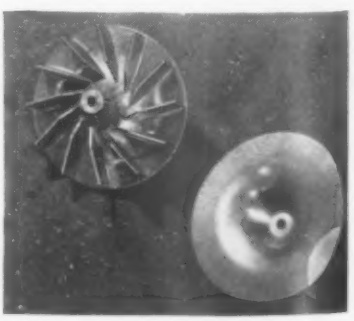

Showing front and back of fan with metal removed to correct unbalance. The entire balancing operation required an average of less than 45 seconds per piece.

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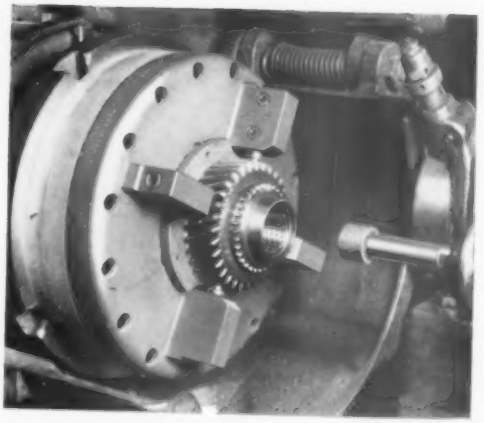

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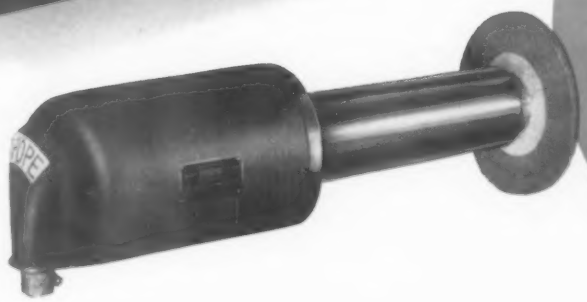

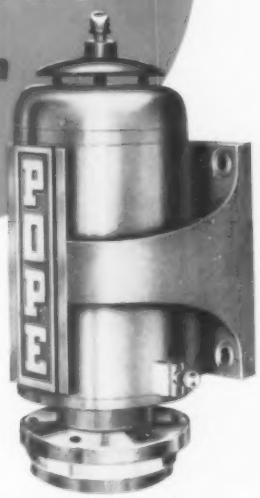

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Bulletin S-2 contains specifications and useful information about this and many other types of Pope Precision Spindles. *Write for it.*

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Specialized wheels by CARBORUNDUM for thread grinding.

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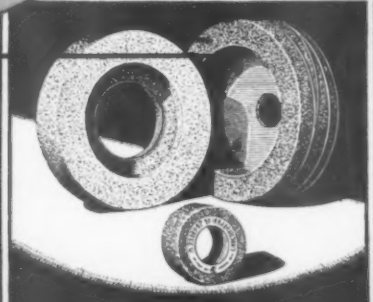
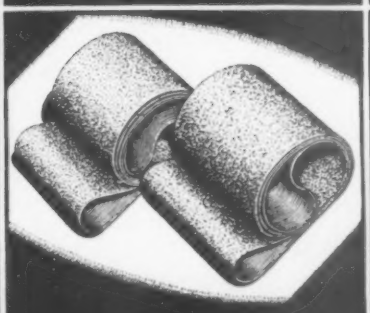


Cool-cutting GREEN GRIT wheels for cemented carbide.



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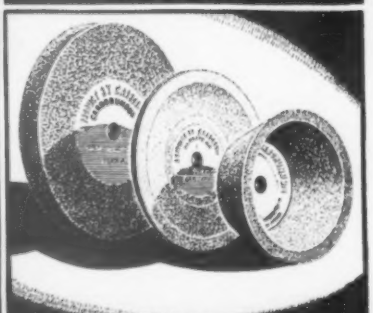

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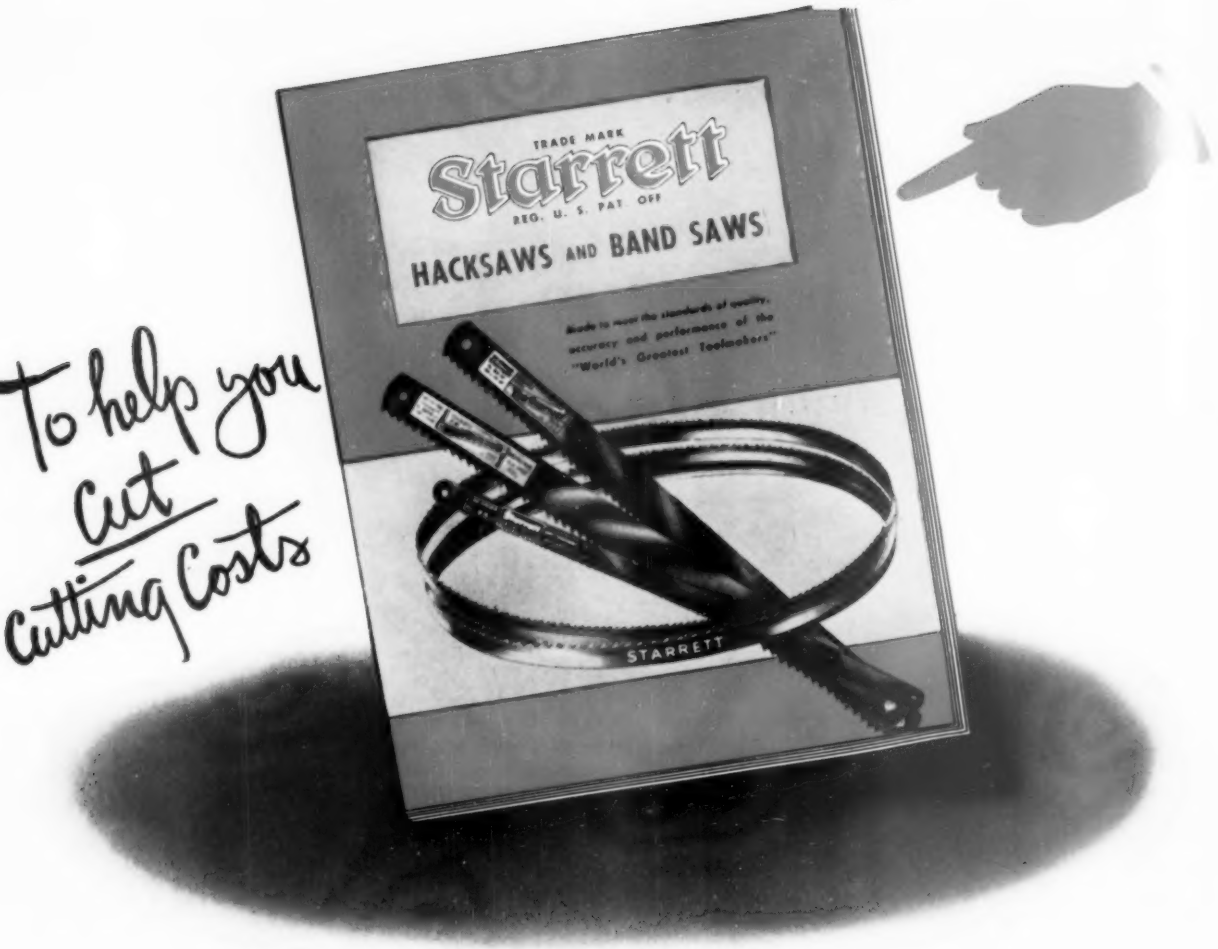

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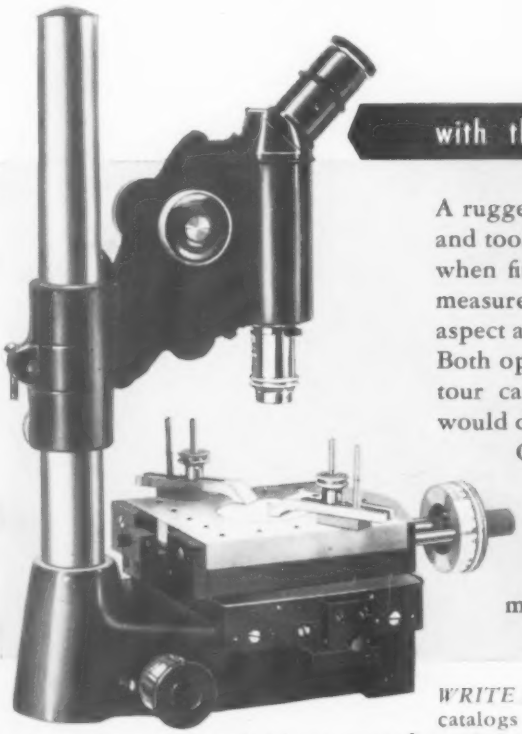

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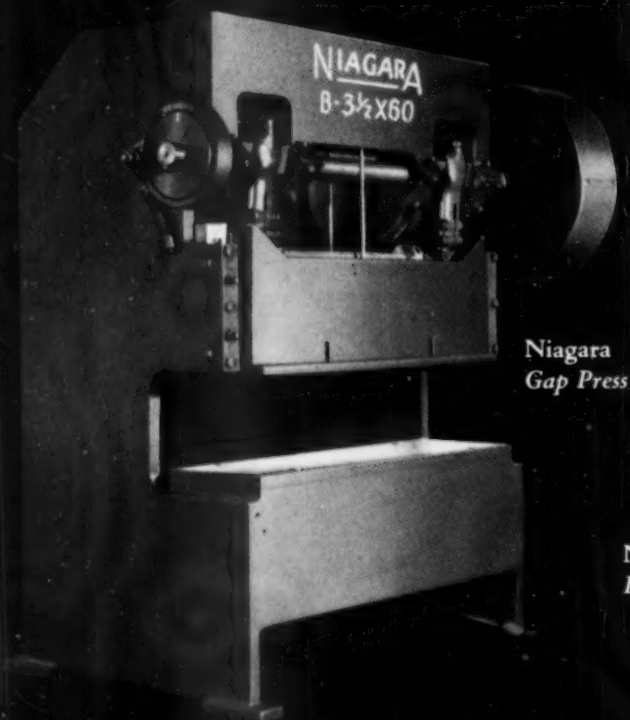

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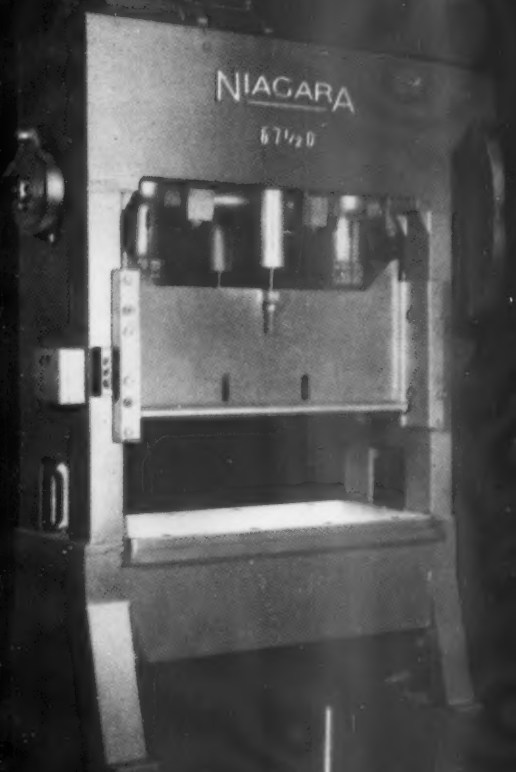

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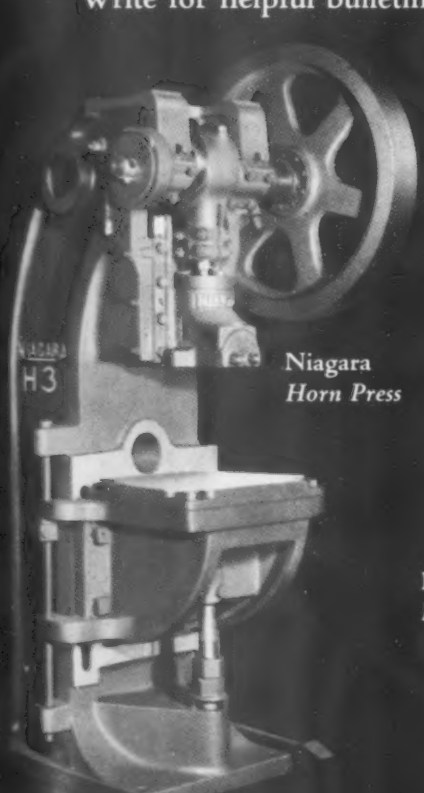

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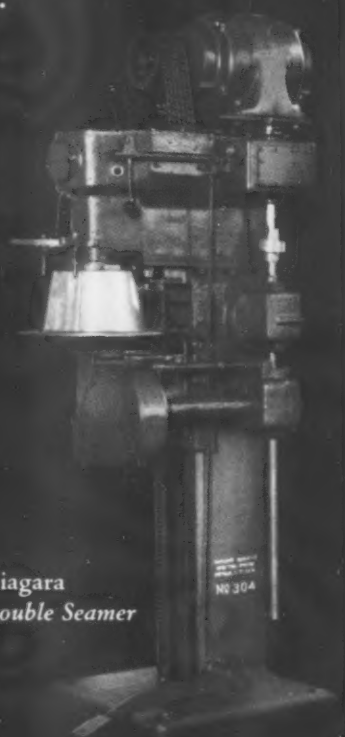

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Niagara
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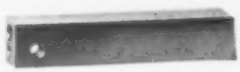
Niagara
Rivet Set and Header



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Niagara
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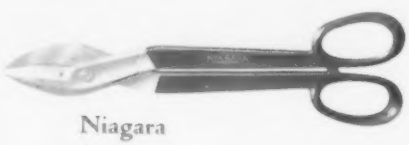

Niagara
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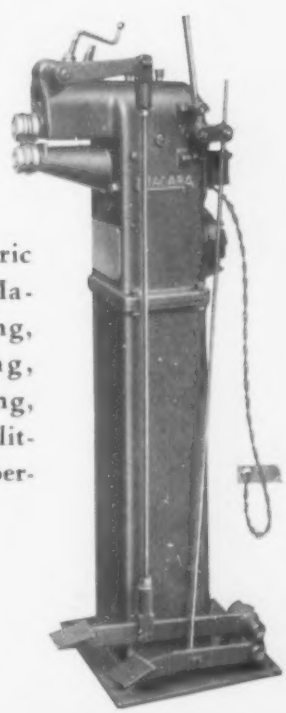


● Niagara Electric Combination Machine for burring, turning, wiring, beading, crimping, elbow edging, slitting and other operations.

Y. District Offices: Detroit, Cleveland, New York

By A. E. Rylander

Cost Cutting with Rotary Swaging

Displacement of Metal, Rather Than Its Removal, Saves Both Time and Material

SWAGING CAN BE DIVIDED into four classes, as follows: Manual, as in blacksmithing; hammering, as where one of two dies is stationary while the other vibrates; squeeze, either by toggle or hydraulic pressure, or a combination of both; and rotary, in which the dies revolve around the work and derive striking power from radially located rollers. Fig. 1 shows a typical rotary swaging machine.

Metal is Displaced, Not Removed

Contrary to lathe work, which shapes metal by cutting, swaging displaces the metal. Consequently, there is but negligible scrap, and this saving, combined with high speed, makes swaging one of the most economical methods for the shaping of metals. With proper tooling, it is also accurate within commercial limits of tolerance. In addition, tool costs are comparatively low—in fact, the dies will compare favorably with the cost of tooling for turret lathe operations and are less perishable.

In manual swaging, the swage—or die—is inserted in the hardy hole of an anvil and the blacksmith holds the hafted upper die in one hand while he slowly turns the workpiece with the other, a helper meanwhile striking with a sledge. This is the basic principle of all swaging, the point being that the work must turn in the dies, or the dies around the work, lest the metal be displaced into a flash such as occurs in drop forging. Hand swaging is employed mainly for occasional or small lot manufacture of punches or drifts, or for shaping or reducing diameters on hand forged parts.

Hammering compares with manual swaging inasmuch as the work turns; also, there is a certain advantage in that the lower die retracts. Thus, one can run a length of tubing through the dies and, by progressive feeding, break the stock down into the final shape which is then cut off. See Fig. 2, which illustrates method of making hollow balls.

A modern hammering machine operates on principles similar to that of a rotary swager inasmuch as the rapidly reciprocating ram is actuated by rollers radially disposed in the spindle head. Movement of the ram is rather slight, being limited in travel from the O.D. of a roller to the interstice between two rollers—say $\frac{1}{8}$" or so.

The number of blows struck per minute is determined by the speed of the rapidly turning spindle, times the number of rollers; hence, the action is vibratory rather than a series of distinctly perceptible blows. The work—bar or tubing—is held in a chuck in a rotating tailstock spindle which may or may not be provided with a step-by-step feed mechanism, depending on the nature of the work.

Squeeze swaging, while important for special applications, has but limited use in modern manufacture. Here, neither the dies nor the work revolve; however, there is a slight turning of one or the other in order to press down the fins which are an inevitable result of the metal displacement.

Advantages of the method are extreme quietness as compared to hammering or rotary swaging, and a typical application would be swaging clevis or ball ends on long lengths of cable—a feat rather impractical with hammering. In the main, however, this article will deal with rotary swaging, the foregoing having been outlined to provide a clearer understanding of fundamental principles of swaging as well as of the tools used and their application to mass manufacture.

Dies Rotate Around the Workpiece

In rotary swaging, the work does not rotate; rather, the dies revolve at high speed around the work, which may be held in chucks, collets or vises, and even by hand. The dies are held in a rotary die head which is an integral part of the spindle. See Fig. 3, which shows the essential components of a rotary swaging machine.

Hammer blocks intervene between the dies and a number of diametrically opposed rollers contained in a retainer, or "cage", somewhat similar to the ball retainer in an antifriction bearing. Pressed into the swager head proper is a hardened and ground ring, comparing with the outer race of a roller bearing. As the spindle turns at high speed, centrifugal force throws the hammer blocks and dies outward, opening the dies; then, as the hammer blocks come in contact with the rollers, they close in, bringing the dies sharply together.

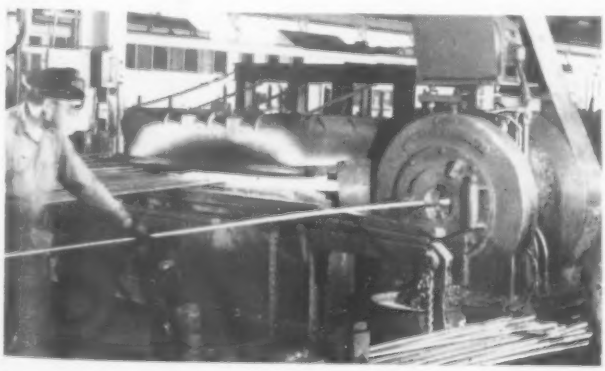


FIG. 1. Reducing the ends of steel tubes, by rotary swaging, at the Pacific Tube Company's steel tube mill, Los Angeles, Cal. The swager shown is by the Etna Machine Company, and the tube ends are preheated in the furnace shown immediate at left of the machine. The tubes are hand fed into the dies, thus indicating the comparatively slight grip required to hold parts. The swaging machine is an Etna, by Etna Machinery Co., Toledo, Ohio.

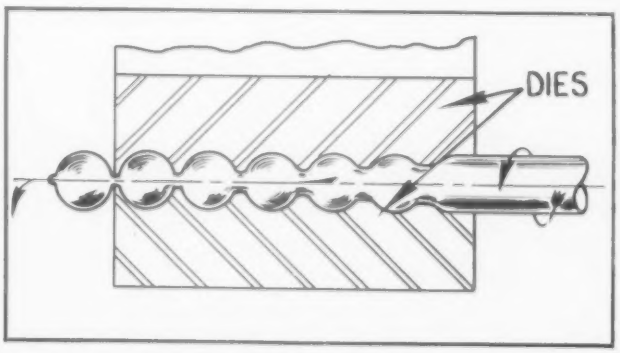


FIG. 2. Diagram showing method of manufacturing hollow balls by hammering. The tube is progressively fed through the several die cavities and the finally rounded ball is cut off as it leaves the last cavity. The lower die recedes for each pass, as indicated by arrow at left, to permit free movement of tube which is held in a collet in a tailstock provided with step-by-step feed. The work is continually turning as shown by arrow at right. Illustration by courtesy of Langelier Mfg. Co., Providence, R. I.

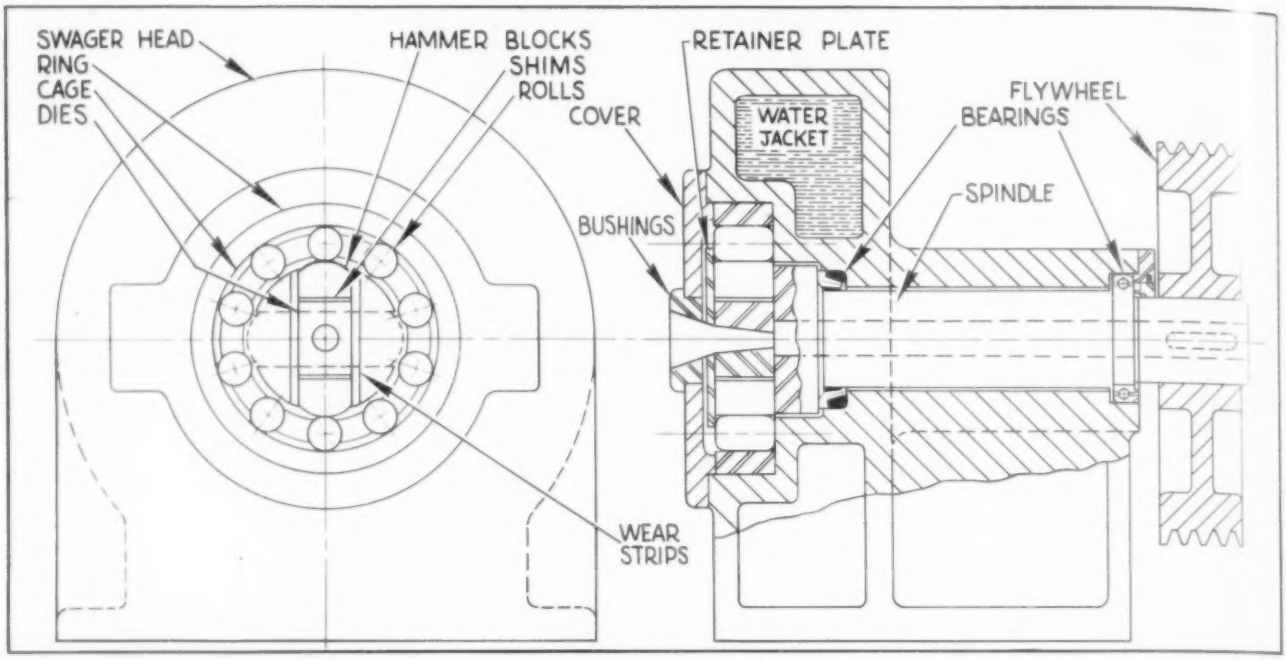


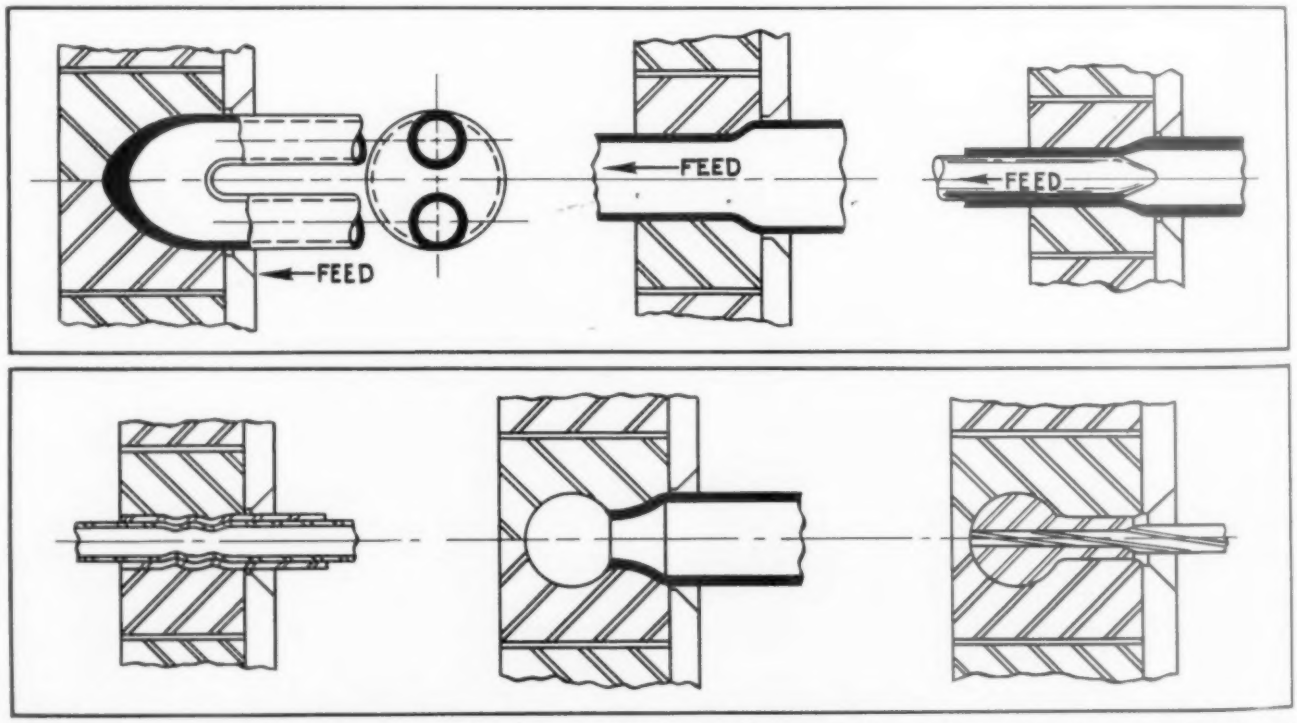
FIG. 3. Front view and section of a rotary swaging head, showing component parts and principle of operation. As the spindle rotates at high speed, centrifugal action throws the hammer block-die combination outward into the interstices between the rollers, thus opening the dies. Then, as the hammer blocks contact the rollers, the dies close face to face. Die adjustment is by means of shims. The cross section shows the cover plate (usually hinged) with guide bushing, retainer plate for the rollers, and the spindle. The latter is hollow, for passage of stock and also for use with sizing mandrels. Larger swaging heads are water jacketed, as shown, to dissipate the heat engendered by severe operations.

Once past the rollers, they immediately fly outward again, to be arrested by the interstices between the rollers. The number of blows struck per minute is directly proportionate to the number of rollers in the cage and the R.P.M. of the spindle. Thus, if there are ten rollers and the spindle runs 200 R.P.M., there will be five blows struck per revolution or a total of 1000 blows per minute. This also holds for hammering.

In Fig. 3, front view, the dies are shown closed on the vertical centerline and open on the horizontal line. It may be mentioned that, for each blow struck, the rollers turn slightly with the impact; this, together with a constant "creep" of the retainer, continually presents a new surface to the hammer blocks and also distributes wear on the ring.

The dies are made to contact face-to-face on closing, the hammer blocks bearing against the rollers with just enough

FIG. 4, at left, shows how steam superheater tubes may be closed by rotary swaging and, at the same time, thickening the resultant "bullet nose" to withstand the erosive action of the impinging steam. FIG. 5, center, shows how tubing is reduced on the O.D. as it is fed through the dies. The metal is displaced and the tube lengthens without loss of material except as subsequent end trimming may be necessary. FIG. 6, at right, shows how both O.D. and I.D. diameters may be controlled. The dies control the O.D., and the mandrel controls the I.D.



FIGS. 7, 8, 9, left to right in order of sequence, show how tubes may be crimped together; how tubing may be tightly closed over a ball end; and how ball, clevis or rod ends may be tightly closed over flexible cable by means of a comparatively recent development. A wedge principle provides extra opening for the dies to permit entry of bulbous shapes.

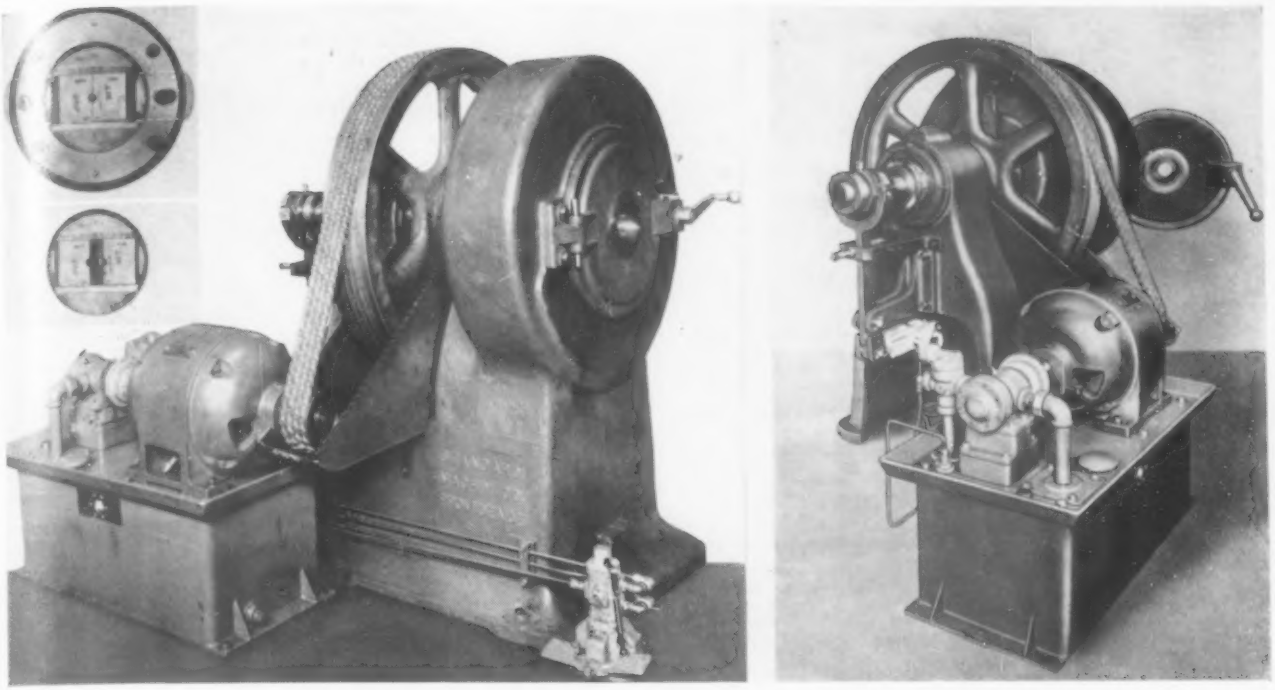


FIG. 10 shows front and rear views, respectively, of the swaging machine (by Standard Machinery Company, Providence, R. I.) developed for swaging bulbous shapes such as shown in Figs. 7, 8 and 9. Wedges, operated by the mechanism shown at rear of machine, and shown in the insets, close and open the dies to permit entry and withdrawal of the larger diameters.

extra pressure to compensate for "give" in the several units —that is, the dies, shims, hammer blocks, rollers and ring. To overcome this resistance, swaging machines are provided with fairly heavy flywheels which also act as driven pulleys. Approved drive is by V-belt. The spindle is made hollow, for passage of stock and for insertion of mandrels, and the head end is either hardened or, if left soft, provided with hardened wear strips.

Applications range from pointing pins—as in jewelry—and reduction of tungsten rod prior to drawing into the fine filaments used in electric light bulbs, to the swaging of heavy bar stock; and from tapering light tubing—as for pencils—to closing return bends in steam superheater tubes, as shown in Fig. 4.

A shape such as this, in which the large end of the dual tubes is about 3" O. D. with roughly $\frac{1}{8}$" wall thickness, can be closed in a matter of seconds. This, however, would be contingent on the time required to heat the tube ends, as swaging of this nature is best done hot. With modern induction heating techniques, however, time of heating and time of swaging should be closely synchronized.

Saving of Material

As previously implied, there is no appreciable waste of metal except as ends may be trimmed in a subsequent operation. Fig. 5 shows tubing being reduced. As the metal reduces in diameter, it is displaced and therefore lengthens in approximate ratio to amount of reduction. The ratio is not direct inasmuch as there is a resultant thickening of the wall when swaging tubing. On the other hand, solid bar lengthens in direct proportion to reduction of diameter.

While wall thickness of tubing, and the lengthening that results from displacement, can be controlled within closely estimated limits, one can definitely control both outside and inside diameters by means of mandrels. For example, if it is desired to reduce a tube 1" O. D. × 1/16" wall to $\frac{7}{8}$" O. D. × 13/16" I. D., this can be done by swaging over a hardened mandrel 13/16" in diameter, as schematically illustrated in Fig. 6. The resultant wall thickness would be 1/32" plus or minus designated limits of tolerance. Preferably, mandrels should turn at spindle speed so as to prevent surface drag.

Swaging Bulbous Shapes

Until recently, it was not practical to swage bulbous shapes such as shown in Figs. 7, 8 and 9, the slight opening of the dies precluding entry of the larger diameter. By means of a wedge action developed by a New England builder of swaging machines,* however, such swaging is not only entirely practical, at this time, but compares favorably in accuracy and speed with the conventional swaging practices with which it is now included.

Thus, one may crimp one tube over another, or threaded fittings or adapters over rubber or armored hose; also, one may swage tubing over ball ends, or ball ends and clevises over flexible cable, as successively shown in Figs. 7, 8 and 9. The action of the machines and the method of opening and closing the dies, are both indicated in the photographs, Fig. 10. Action is automatic and extremely fast.

One advantage, unique with swaging, is that material is

* Standard Machinery Company, Providence, R. I.

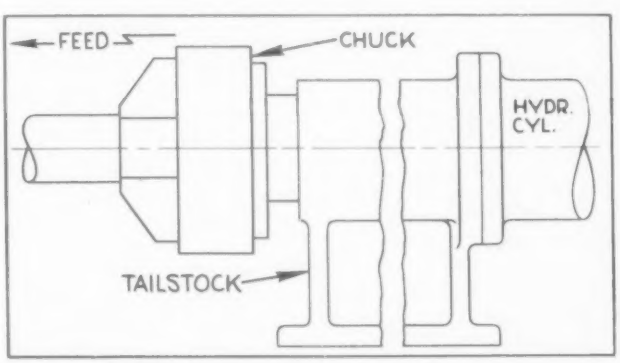
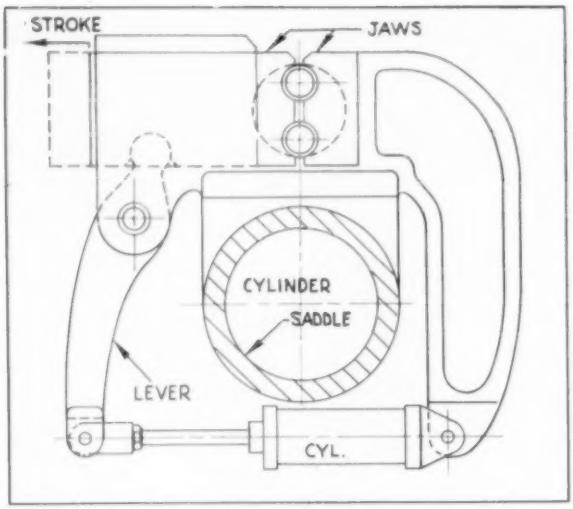


FIG. 11 is a schematic diagram of a tailstock, equipped with a hydraulic cylinder, for feeding tubing or bar stock into the dies. Work is gripped by a chuck, which may be wrench or air operated, as desired. For smaller work, spring collets could be used instead of the chuck.



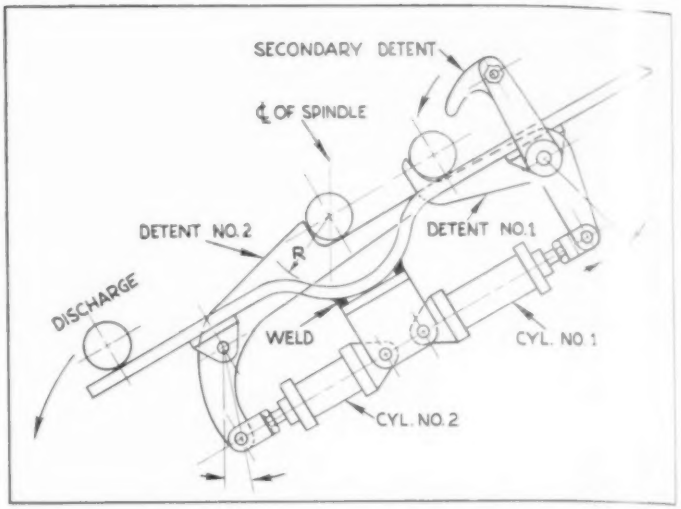


FIG. 12. Diagram of vise which may be used for such work by holding the steam superheater tubes shown in Fig. 4. The vise assembly is incorporated on the feed ram and on the return stroke, a valve closes the small cylinder, thereby opening the vise jaws. As the work is thrown into the vise and feed starts, the clamping cylinder opens and closes the jaws. Action is practically automatic.
FIG. 13, at right, a schematic diagram of an automatic loading mechanism. The work flows by gravity down an incline and is arrested by a detent, similar to an umbrella catch and provided with a secondary detent. On the back stroke of the feed ram, detent No. 2 is in receded position, permitting the swaged part to be discharged. At extreme back of stroke, this detent rises, whereupon cyl. No. 1 recedes detent No. 1, permitting one workpiece to roll into loading position. A secondary detent arrests the following workpieces. As the work is gripped and the ram advances, detent No. 2 recedes, permitting work and holder to move forward in the clearance provided by radius R. Cycle repeats. This is but one of many methods for automatic feeding of work in swaging machines.

not weakened as a result of metal removal, as in the case of turning or other cutting operations. If anything, the metal becomes stronger and tougher as a result of the peening action of the dies. As a pat analogy, take wire drawing, in which comparatively soft materials—as copper and brass, for instance—become hard and springy as a consequence of being drawn through the dies.

While hand feeding is employed to a considerable extent, especially for small work and even on larger work where extreme accuracy is not a factor, mechanical or power feed is preferred. Ram feed, as with rack-and-pinion and capstan—similar to that of a hand-operated turret lathe—is widely used.

Hydraulic Feed Preferred

Where sharp reductions or steep angles are involved, however, hydraulic feed is preferred to mechanical since the fluid presents a more or less solid backing for the severe, recurrent end thrusts. A typical hydraulic feed is shown in Fig. 11; here, a spindle pushed by a hydraulic cylinder travels through a tailstock. The work is gripped by a chuck.

While the majority of parts being swaged may be gripped by standard chucks, collets or vises, there are times when the nature of the work demands special holding devices. Shown in Fig. 12 is a special vise design such as would be applicable to holding the superheater tube shown in Fig. 4.

In this case, the cylinder—which also acts as the ram—slides on the piston and forms a saddle for the vise assembly. The latter is self-contained, with all forces reacting against the vise assembly. A smaller cylinder opens and closes the vise jaws, thrust being taken against the "crotch of the pants legs" of the part being swaged. Action of a work holder of this type—which, incidentally, is but one of many—is entirely automatic, the jaws opening at the end of the return stroke and closing as soon as the ram starts its forward travel.

About the only valid disadvantages that can be charged against rotary swaging are noise and the fact that, until recently, there has not been sufficient thought directed toward automatic loading. But then, that also holds true for most larger work on the general run of machine tools, automatic loading and hopper feeds having been largely confined to smaller parts.

Automatic Loading

While many of the methods applied to loading bar stock into automatics could well be applied to swaging machines, there is the consideration of clearance to permit passage of ram and work holders. One method of loading and unloading is shown in Fig. 13 and generally described in the caption. Attachments to the machine are not shown; rather, the drawing is confined to essential components with complete omission of confusing details. One advantage of a loader of this type is that the entire mechanism, ram and work holders included, can be operated from one hydraulic pump unit provided with the necessary valves.

As for noise, that is admittedly a drawback but can be materially reduced by mounting the machines on vibration dampening cushions and by lining department walls with sound absorbing sheeting designed to dampen reverberation. For that matter, the smaller machines emit nothing worse than a loud hum which rises to a momentary snarl as the work is fed into the dies.

A marked advantage, as far as economy is concerned, is the comparative simplicity of the dies. As a general rule, these can be clamped face to face in a lathe and the cavities bored out. After hardening, and with the mating faces ground, the cavity may then be finished on an internal grinder or polished smooth. The dies may be redressed over and over again, thus extending life indefinitely. As adjustment is by means of hardened and ground shims, the wear factor is negligible.

An Economical Process

As previously implied, the variety of shapes—provided that they are diametral and symmetrical around the longitudinal axis—that can be produced by rotary swaging is almost limitless. And a particular advantage of swaging is that it does not required skilled help. Like broaching, in which the accuracy is built into the broach, accuracy in swaging is built into the dies, and if the dies are right, then practically any unskilled or semi-skilled operator can produce good work. And, combined with modern induction heating, where heat is required, and properly designed automatic loading devices, the method offers high-speed production with, in the majority of cases, adequate accuracy.

By **Robert B. Douglas**

Compulsory Licensing of Tool Engineers?

A.S.T.E.'s First Vice President and, last year, Chairman of the Committee on Professional Engineering, digests a knotty problem on the Committee's Annual Report.

THE MOVEMENT toward the compulsory licensing of all engineers is continuously spreading. What the implications of this movement are, what its effects will be upon the status of all in the actual practice of tool engineering, and what to do about it, are of vital concern to all tool engineers and to the community they serve.

The Nature of Compulsory Engineering Legislation

The compulsory licensing acts of the various states grew out of the very commendable desire of the engineering profession itself to regulate their practices so as to protect the life, health and welfare of the public against the consequences of ignorance, incompetence or malpractice. The movement sprang up within engineering groups and was not originally imposed from outside.

The A.S.T.E. Committee on Professional Engineering believes that registration or certification is necessary for persons engaged in the engineering design and erection or installation of certain types of machinery, structures or pressure vessels whose failure could have serious consequences to many people. However, the areas of such danger are only a small fraction of the entire field of engineering, and that to extend the public safety and welfare to the whole field is not justified by the facts.

A registered professional engineer has standing in the industrial world

In most states, the practice of "engineering" or professional engineering is broadly defined as follows:

"The term *practice of engineering* within the meaning and intent of this Act shall mean any professional service or creative work requiring education, training and experience and the application of special knowledge of the mathematical, physical, and engineering sciences to such professional services or creative work as consultation, investigation, evaluation, planning, design, and supervision of construction for the purpose of assuring compliance with specifications and design, in connection with any public or private utilities, structures, buildings, machines, equipment, processes, works, or projects.

"A person shall be construed to practice or offer to practice engineering, within the meaning and intent of this Act, who practices any branch of *Engineering*: or who, by verbal claim, sign, advertisement, letterhead, card, or any other way represents himself to be a *professional engineer*, or who holds himself out as able to perform, or who does perform any *engineering service* or work or any other professional service designated by the practitioner or recognized by educational authorities as *engineering*."

By logical extension of so sweeping a definition, it can be seen that the simple act of boiling an egg can be described as "the supervision of a process requiring professional knowledge of the application of physical principles," and must therefore be carried out only by properly qualified persons licensed by the State Board!

President of Godscroft Industries, Ltd., of Canada, Robert B. Douglas, is a member of Montreal Chapter, ASTE, a member of the Board of Directors and First Vice President of the Society.

Inequities of Compulsory Licensing

1. By *legislative act* the practice of engineering, whether it be called by that name or not, is restricted to persons who are members or licensees of a private professional corporation or State Board.

2. The definition of *engineering* is so broadly drawn that it becomes virtually the interpretation of these private individuals, in whose decision is rested absolute authority without judicial appeal. To these persons, then is granted by the state a virtual monopoly with the power to regulate fees (prices) and set the terms of admission (restrict competition).

3. On such licensing boards is also placed the responsibility for summoning before the courts persons charged with practicising illegally (delegation of police power).

Hence, this body becomes at once the policeman, accuser, judge, and jury.

4. There is a present underground tendency to use the professional licensing bodies, either directly or through affiliates, as *collective bargaining* agencies on matters of wages and hours. This, coupled with a legalized professional monopoly, can have serious effects upon the profession itself, and be against the public interest which is entitled to protection against unregulated rate increases.

No Provision for Licensing Tool Engineers

What might be listed as a fifth inequity of compulsory licensing, so far as concerns A.S.T.E. members, is the fact that only two states—Missouri and Washington—presently acknowledge Tool Engineering as a separate branch of Engineering.

It is remarkable that in a country whose economic vigor stems so largely from its productive genius, such scant recognition is accorded the "Production—" or "Tool Engineer."

Emphatically, it is a separate branch of engineering with its own body of laws, principles and practices, insofar as it is chiefly concerned with the processes of the mechanical transformation of form in matter, as opposed to "Product Engineering" and "Heat Engineering" which are primarily concerned with the design of structures and the transformation of energy respectively. However, when this difference is examined practically, it becomes evident that the Tool Engineer must have a thorough grounding in the other two fields before he can begin to work in his own field.

One of the prime reasons for this lack of recognition of "Tool Engineering" as a separate profession, has been the lack of direct pressure that has been brought to bear on the Professional Boards to obtain that recognition. However, entirely aside from that, there appear to be several basic factors which have militated against it:

1. Failure to understand the nature of Tool Engineering.
2. Belief that it is more *art* than *science*.
3. Belief that it is a specialty within one phase of "Mechanical Engineering."
4. Genuine desire to prevent needless complexity of professional structure.
5. Lack of acceptance, by Universities and Colleges, of "Tool Engineering" as a separate course.

Permissive Legislation One Solution

In a few states, permissive laws enable persons qualified and desiring to do so, to register with the State Board as professional engineers, to obtain that legally recognized status. This plan, making registration mandatory only where the safety and welfare of the public is involved, accords more closely with the principles of our democratic society and preserves the stimuli of free competition.

Under permissive legislation, those Tool Engineers could obtain official certification so as to serve the public interests where safety and security are essential, and also those private interests who need such services but are unable to adjudge the engineer's competence. It would, moreover, leave those Tool Engineers free to remain in their present status, who are employed on salary by industrial companies who *are* competent to judge their abilities.

It is very much to the interest of Tool Engineers to urge the maintenance of permissive registration in those states in which it is in force, and to urge its adoption in the other states.

Register If It Is Mandatory

Where A.S.T.E. members are able to qualify for registration under the present Acts governing in their states, they are urged to do so. At present, requirements are not too rigid, but it is impossible to predict what will be the conditions in the future; they can scarcely grow less onerous. For reasons of personal insurance, there should be no delay in qualifying or trying to do so.

There are three methods of qualifying:

1. *Grandfather's Clause.* Anyone practicing engineering and holding a recognized position at the time of the passage or alteration to the Act, on presentation of credentials before a set date will automatically be licensed to practice with examination, with or without college degree.

2. *Engineering Degree From Recognized College.* Some states will grant recognition to college graduates on basis of diploma alone; others require proof of a stated number of years of responsible practice; requirements vary widely and should be investigated locally (see your State Board of Engineers, usually at the state Capitol).

3. *Examination.* This is almost universally required of men not holding a degree. They vary widely in severity. Some states require considerable refresher study. In other states, examinations are virtually a matter of form and should be passed by anyone with the equivalent of high school mathematics and physics. In many cases, so many elective questions are presented for applicant's option that he is almost sure to find enough questions relating to his everyday work to enable him to pass without special study.

What Examinations for Tool Engineers?

Except for Missouri and Washington, there being no states provisions for qualifying as a professional Tool Engineer under that title, examinations are for Mechanical Engineer. Requirements vary from state to state but, generally speaking, comprise:

Part I—Common to all Branches:
1. Mathematics
2. Physics
3. Elementary Chemistry

Part II—Common to all Branches:
1. Economics
2. Professional Ethics

Part III—Specialized questions according to Branch

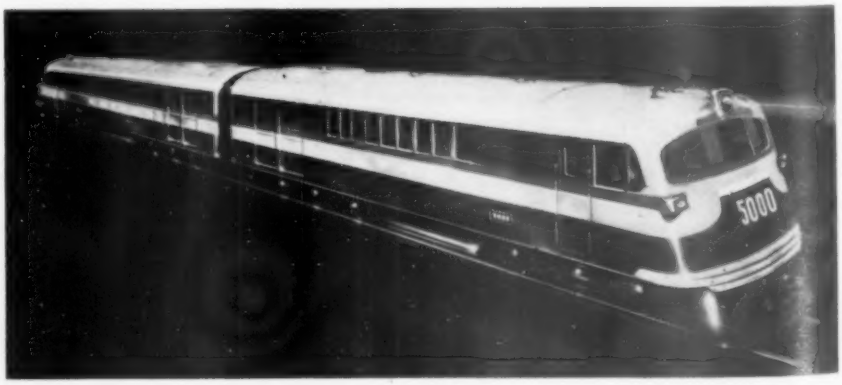
In mechanical Engineering, Part III, specialized examinations usually deal with mechanics, machine design, hydraulics, and thermodynamics.

Recognition of a Tool Engineering classification for registration should be vigorously and continuously sought by the members through (a) personal contacts with permanent officials of the State Board offices; (b) by briefs to the professional bodies; (c) through constructive articles in technical journals. Where the direct Tool Engineer classification seems too difficult to push through, for practical purposes recognition as a Sub-Division of Mechanical Engineering is equally desirable. Compulsory registration should in all possible cases be resisted, and permissive registration advocated and sponsored.

Argentine Streamlines Its Railways

The Argentine State Railways has accepted final design drawings for 65 double-unit diesel-electric locomotives. These locomotives will be constructed under an $18 million dollar contract awarded the General Electric Company.

According to E. F. O'Dair, transportation specialist for the International General Electric Company, the locomotives feature compact design with streamlined appearance and are being built in three types to cover unusual operating conditions found on Argentine's railroads. The largest of the three types will be a 2000 HP unit for operation in the Andes, where grades are 2½ per cent at 15,000 ft. altitudes.



By J. W. Lengbridge

34-92000

Reduction Factors in Drawing Operations

Installment No. 5 of a Series on the Theory and Practice of Pressing Aluminum

THE PRECEDING INSTALLMENT concluded with the cautioning note that severe reduction of diameter and reduction of wall thickness, of drawn parts, should not ordinarily be attempted in the same operation. The reason is that the severe stresses imposed on the metal will result in fractures, as shown in the photograph, Fig. 41.

Die Space, Drawing Clearance And Pressure

The die space usually allowed for drawing any metal should be proportional to the metal thickness plus an allowance to prevent wall friction. Known as the clearance, this allowance ranges from 7% to 20% of the metal thickness, depending on the type of operation, metal, and other conditions. Table I outlines typical die space dimensions for use in drawing aluminum. The clearance suggested for sizing draws is not sufficient to produce an ironed finish since, for drawing operations which must produce a burnished finish, the clearance should be equal to "t"—metal thickness—less 8% or more, depending on the metal, the type of product, and the diameter reduction taking place in connection with the ironing.

Be reminded that a drawing operation must produce, from a flat bank, a hollow shell free from wrinkles or puckers and of fairly uniform thickness. A punch pressing on the center portion of the blank draws the metal into a die, and blankholder pressure on the outer portion prevents the metal from wrinkling and puckering. This pressure which tends to retard the movement of metal into the die, opposes the pressure being applied on the bottom of the shell.

The movement of metal toward the die radius induces compressive stresses in this area which tend to increase the thickness of the metal and, by filling up the space between the blankholding faces, to increase the blankholding pressure. All of these factors constitute a resistance to flow which must be overcome by the punch pressing on the bottom of the shell. The metal between the bottom area and the area held by the blankholding pressure is thus subjected to tensile stresses.

As resistance to flow increases, tensile stresses also increase, and such conditions as excessive blankholding pressure, excessive diameter reductions, sharp draw radii, wrinkle formation, insufficient lubricant, and friction from rough tools all tend to retard or prevent flow and to increase the pressure necessary to draw the metal into the die. In most draws, all of the flow occurs between the blankholding faces of the tools, and the total resistance to flow in this area determines the magnitude of the tensile stresses in the vertical side walls of the shell necessary to overcome this resistance.

TABLE 1. DRAW CLEARANCE

BLANK THICKNESS, IN.	1ST DRAWS	REDRAWS	SIZING DRAW
Up to .015	1.07t to 1.09t	1.08t to 1.1t	1.04t to 1.05t
.016 to .050	1.08t to 1.1t	1.09t to 1.12t	1.05t to 1.06t
.051 to .125	1.1t to 1.12t	1.12t to 1.14t	1.07t to 1.09t
.136 and up	1.12t to 1.14t	1.15t to 1.2t	1.08t to 1.1t

NOTES: t=the thickness of the original blank. *=used for straight-sided shells where diameter or wall thickness is important, or where it is necessary to improve the surface finish in order to reduce finishing costs.

This series of articles is a collaboration between the author, Mr. Lengbridge, and Aluminum Laboratories, Ltd., of Kingston, Ontario.

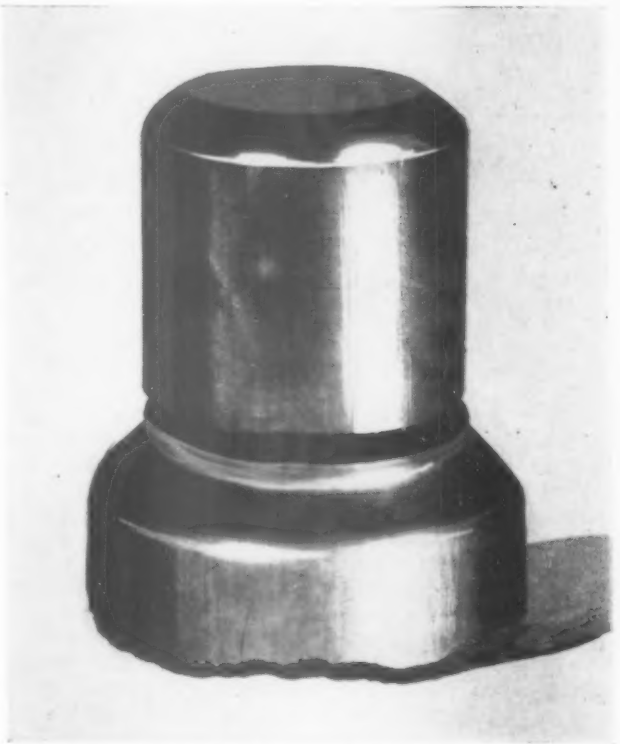


Fig. 41 shows the result of attempting wall and diameter reduction in the same operation when drawing an aluminum shell. In this case, the reductions were 27% and 15%, respectively. Either reduction would have been possible if performed alone but, with both attempted in the same operation, fracture resulted since the metal was not strong enough to withstand the high tensile loads. However, a reduction of 10% to 20% in wall thickness, and 3% in diameter, is possible with the common aluminum alloys. Some of the stronger alloys may withstand over 20% reduction if wall thickness of reduction of diameter is not too severe.

Plastic Range

As regards diameter reduction, the area of metal held between the blankholding faces must be reasonably proportional to the area on which the punch is pressing. In other words, there is a limit to the amount of metal which can be made to flow in one operation. The greater the difference between blank and shell diameters, the greater the area must be made to flow; in consequence, the higher the tensile stress to make it flow.

If resistance to flow is too great because of any of the foregoing factors, the force necessary to make flow possible may exceed the strength of the metal being drawn, resulting in fracture. In drawing operations, therefore, the pressure necessary to cause flow must lie between the yield point and the ultimate strength of the material being drawn. Pressure must exceed the yield point in order to permanently change the shape of the metal, yet, must not reach the ultimate strength lest fracturing result.

The range between these two points—known as the "plastic range"—is reduced by cold working because, as the metal work-hardens, its yield strength rises more rapidly than the ultimate strength. For instance, one draw of 45% reduction on Alcan 3S-O will increase the temper in the side walls to ½ H. In this connection, there is a difference of 10,000 psi between the yield point and ultimate strength of Alcan 3S-O, and only about 3,000 psi in the case of Alcan 3S-½H, the latter having a considerably smaller plastic range.

Calculating Drawing Pressure

In his book, "Plastic Working in Presses", E. V. Crane applies—by reversing the stress directions—the formula for the bursting strength of thick pipe to drawing metal in dies and arrives at a formula, for drawing pressure, which takes into consideration the relation between the blank and shell diameters. As stated earlier, this is one of the factors affecting the pressure requirements. The formula follows:

$P = \pi\ dtSy\ (\frac{D}{d} - C)$, where P = total applied drawin pressure; d = mean diameter of the shell; t = metal thickness; D = blank diameter; Sy = Yield strength of annealed metal in psi; and C = a constatnt of 0.6 to 0.7 to cover corner bending and friction.

Shell Strength

The side-wall metal is essentially a tube in tension, and its strength is the cross section area multiplied by the ultimate strength of the metal. Therefore, the shell strength may be expressed in the formula: $P_{max} = \pi\ dtS_t$. Where P_{max} = total breaking pressure (minimum); d = mean diameter of the shell; t = metal thickness; and S_t = ultimate strength of annealed metal in psi.

The minimum total breaking pressure is that pressure, calculated on the basis of annealed metal, required to pull the bottom out of the shell. However, the actual breaking pressure is higher, depending on the extent to which the metal has been hardened during the draw.

It should again be noted that the values S_y and S_t, in the foregoing formulas, are minimum values which only hold while the material is in the annealed state—that is, the temper usually used for deep draws. Because these values begin to rise as soon as drawing starts, and continue to rise as long as the material is cold worked, the actual values of S_y and S_t are difficult to determine at any one moment in the drawing cycle. Tests made on sections of drawn shells, after one, two, and three draws, show the change in these two values, and the rate of the change may be measured by plotting the values of S_y and S_t with the reduction percentage.

Typical Calculations

As plasticity is reduced, these two values come closer together because of a difference in the rate of change due to cold working and, for calculation purposes, the values used for S_y and S_t should be increased above those for annealed metal approximately 100% and 15% respectively. The formulae should only be used to get an approximate picture of the relative pressure and shell strength.

For instance, consider a shell 5½ in. diameter to be drawn from a 12 in. diameter x ⅛ in. thick Alcan 3S-O blank. Assuming values of 12,000 and 18,000 psi for S_y and S_t, drawing pressure and shell strength would be respectively as follows:

$P = \pi\ dtS_y\ (\frac{D}{d} - .7) = 3.14 \times 5.5 \times \frac{1}{8} \times 12{,}000\ \frac{12}{5.5} - .7) = 38{,}000$ lbs.

$P_{max} = \pi\ ndtS_t = 3.14 \times 5.5 \times \frac{1}{8} \times 18{,}000 = 39{,}000$ lbs.

The reduction in this draw is 55%—well above recommended practice—and the pressure necessary to cause flow is much too close to the shell strength for satisfactory operation because of the danger of high scrap losses due to shell failure at local weak points.

If, therefore, the first draw was made 6-¾ in. diameter—that is, 43-½% reduction—the drawing pressure would be lower because less material is under stress in the flow area, and the strength of the shell would be higher because the section is larger. The drawing pressure would be about 28,000 lbs., the strength of the shell 46,000 lbs., and there would be little danger of fracture due to drawing loads unless some other factor—such as lack of lubricant, roughened dies, or inferior metal—entered into the operation to retard the normal flow of metal or to cause failure. The 6-¾ in. diameter shell could then be given a further reduction of 19% by redrawing, and the shell size of 5-½ in. diameter obtained.

Diameter Reduction

In the discussion of drawing pressure, the term "reduction percentage" was used in connection with the relative diameters of the blank and the shell. For the first draws, this reduction percentage is obtained by first determining the difference between the diameter of the original blank and the diameter of the drawn shell, then expressing as a percentage the ratio of this difference to the original blank diameter. For redraws, the diameter of the shell to be redrawn, and the diameter of the redrawn shell, are used to calculate the reduction percentage. The total reduction in cases of two or more draws is, of course, calculated from the original blank diameter to the final shell diameter.

Reduction Formula

The reduction in outside circumference due to compressive stress on the flange is a proper measure of work done upon the metal in the process of plastic working or strain hardening. As a reduction in circumference, this would be expressed as follows:

$\frac{\pi D - \pi d}{D}$ which, since π cancels out, reduces to $\frac{D-d}{D}$

in which D = the blank diameter, and d = the drawn shell diameter.

This is the usual reduction formula used to determine the amount of drawing a blank may be given in one operation. If this reduction is the maximum which can be made on the metal drawn, without excessive straining or fracturing, it is described as a "*limit draw*."

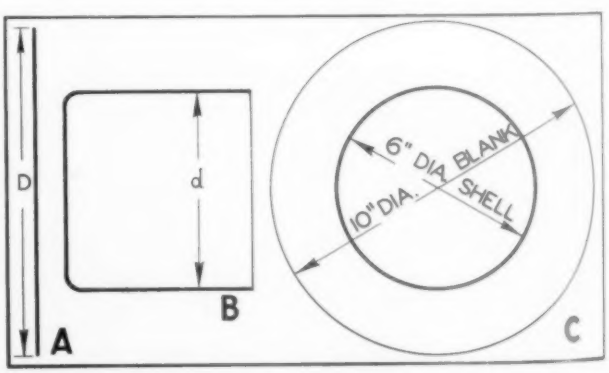


Fig. 42, which illustrates the term "percentage reduction," shows at A, B, and C respectively, a 10 in. diameter blank, a 6 in. diameter shell drawn from this blank and a plan view of both the shell and the blank. Reduction = D–d/D × 100 = 10–6/10 × 100 = 40 per cent.

The ratio between the diameter and the depth is also sometimes used to express the cold work given to a blank, but is only reliable in cases of absolute free drawing. If the die space is such that ironing takes place on the side walls during the operation, the wall thickness will be reduced, thus increasing the overall area. The amount ironed off the wall metal is not lost, as in a machining operation, but increases the depth of the shell and, in cases where severe ironing occurs, considerable depth can be gained at the expense of thickness by an increase in area. See Figs. 42 and 43.

Reduction Limitations

It is generally possible to obtain greater reductions per operation on double-action mechanical and hydraulic presses than on single-action press equipment. The former types are designed for drawing and include, in their mechanism, facilities for constant blankholding pressure throughout the stroke, while the latter are dependent on supplementary equipment—such as springs, rubber or mechanical cushions—to apply the blankholding pressure. And with any of these, uniform pressure throughout the stroke is difficult to obtain.

It should be remembered, however, that limit draws on any type of equipment will necessitate better quality tools, more care in their finishing, and more servicing to keep them in first class drawing condition, as well as greater care in lubricating the work.

If the shell diameter and depth are such that more than one draw seems advisable, the diameter reductions for each of the redrawing operations should be less than the one preceding it. That is, a series of draws should be on a reducing scale, because each draw will work-harden the metal, and increase resistance to flow, thus making further cold work at each draw more difficult.

Thickness Ratio

It has been stated that one of the factors affecting flow resistance is the reduction percentage. There are other factors, however, which must also be considered, since they play quite an important part in the success or failure of the operation. For example, the ratio of blank diameter to metal thickness is very important. This is known as the "thickness ratio", and is expressed as t/D, in which t equals the metal thickness and D the diameter of the blank. As this ratio decreases, the tendency to wrinkling increases, necessitating more blankholding pressure to prevent wrinkles from starting.

Because of this, it is necessary to reduce the flow area by using a lower reduction percentage. The higher pressures usually demand better quality die material and more careful lubrication of the blanks, especially so since the thinner the metal in relation to the blank diameter, the more difficult it will be to make a maximum reduction. Such factors as die radii, which would be proportional to the metal thickness; blankholding pressure, which varies with the wrinkling tendency; as well as with the shape being drawn, are all variables which must be correct for the particular job under consideration.

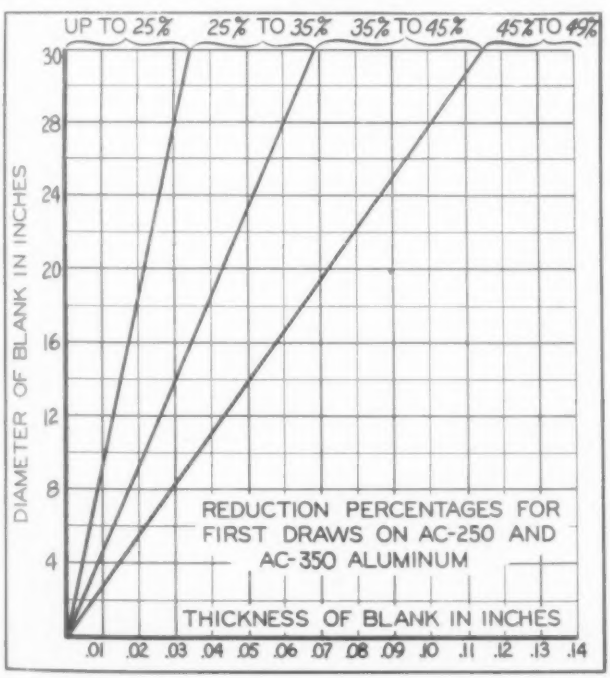


Fig. 43, showing recommended reduction percentages for first draws on Alcan 2S-O and Alcan 3S-O. This chart may be used as a guide in selecting the reduction percentage to use for various blank diameters and thicknesses. It is based on actual practice but, like most charts of its kind, should be used with discretion. It is not designed to eliminate the need for analysing each job, and the reductions suggested are not necessarily minimum or maximum values.

TABLE 2. REDUCTION PERCENTAGES FOR FIRST DRAWS

PERCENT THICKNESS RATIO: t/D × 100			PERCENT REDUCTION IN DIAMETER: D-d/D × 100
Double-action with blankholder	Single-action with blankholder	Single-action without blankholder	
.15	25	2.0	35
.25	30	3.0	40
.40	45	4.0	45
.50	55	5.0	48

Reduction Percentage

Table 2, showing percentages for first draws, takes into consideration the thickness-diameter ratio and will serve as a general guide for determining the initial reduction on the non-heat-treatable aluminum alloys—such as Alcan 2S-O or Alcan 3S-O—usually used in our deep drawing operations.

The reduction percentages shown in this table for various values of t/D should not be considered as absoulte limits since they may be exceeded under certain conditions, and, under other circumstances—as, for example, if the material is below standard—may have to be reduced.

Many of the little faults which retard metal movement can be eliminated one after another if sufficient time is spent working the tools into production. The closer all of the contributing factors can be brought to an ideal set of conditions, the easier will be the flow of metal into the die. An average pressing, in an average shop, must be in production with a minimum of nursing and with little or no time spent in experimenting or development. When, however, pressings are required in large quantities, a week or a month spent in development on experimental tools may make it possible to exceed the theoretical reductions by 3% to 10% and to eliminate an operation which, on a long production run, will more than pay for the time so spent.

Effect Of Thickness Ratio On Reduction

Assume that tools are required for a double-action press to make two shells, both 6-¼ in. diameter by 4-½ in. deep with the metal thickness of one shell .072 in., the other .030 in. The blank diameter necessary to produce a shell of this diameter and depth is about 12 in. First calculate the thickness ratio of these two shells in order to determine the maximum reduction possible, as follows:

Shell No.	Blank Dia. (D)	Thickness (t)	t/D x 100
1	12 in.	.072 in.	.60%
2	12 in.	.030 in.	.25%

Checking these thickness diameter ratios with Table 2, it is seen that shell No. 1 can be drawn in one operation of 48% reduction. The blank for shell No. 2 has a thickness diameter ratio of .25 and should not be given more than about 40% reduction in the first draw. This, of course, would not reduce it to the shell size of 6-¼ in. diameter, and would make necessary a redrawing operation to obtain this diameter. The draw data is shown below.

Shell No.	Blank Dia.	Reduction 1st Draw	Reduction 2nd Draw	Shell Size 1st Draw	Shell Size 2nd Draw
1	12 in.	48%	...	6-¼ in.	...
2	12 in.	35%	20%	7-¾ in.	6-¼

There would be a much greater tendency to wrinkle in the case of shell No. 2 than No. 1. And if the former were attempted in one draw, the resistance to movement of the metal would be high because of the severe blankholding pressure necessary to prevent wrinkle formation; therefore, a high percentage of scrap would probably result. The lower wrinkling tendency of shell No. 1 would involve less blankholding pressure, and the flow could take place freely, thus making possible a greater reduction. This example illustrates the importance of considering all the factors before deciding on the method of manufacture.

Summary Of Reduction Factors

Reduction factors in free drawing, considered in detail in the foregoing sections may be summarized as follows:

(1) The reduction in diameter, rather than the diameter-depth ratio, should be used as a basis for determining the amount of drawing a blank may be given.

(2) Limit draws should be be attempted without considering all the factors involved, and should rarely exceed 48% reduction, even for deep drawing metal.

(3) The reduction percentage to use is dependent to some extent on the thickness-diameter ratio.

(4) Since no two batches of metal are identical in every respect, the reductions should not be too close to absolute limits, because the variations in metal temper, thickness, and properties, may be sufficient to prevent consistent results.

(5) Where two or more draws are necessary, a descending scale of reduction should be used.

Redrawing

The discussion thus far has been mainly concerned with shells which could be drawn to size in one operation. Since there is a definite limit to the amount of cold work which may be given to a blank in one operation, it is obvious that several draws may be necessary to shape a shell which is deep in proportion to its diameter. The greater the depth in proportion to the diameter, the greater will be the area under stress, and the more difficult will it be to plastically work without strain or fracture. In such cases, the total amount of cold work necessary to reshape the blank is spread over two or more operations.

When To Redraw

In free drawing, when little or no ironing is taking place, it may be stated as a general rule, that, when the depth of a shell is more than about 70% of its diameter, the reduction percentage necessary to draw it to size will be too high for one operation. The contour of the shell also has a bearing on the number of drawing operations which may be necessary to completely shape a shell.

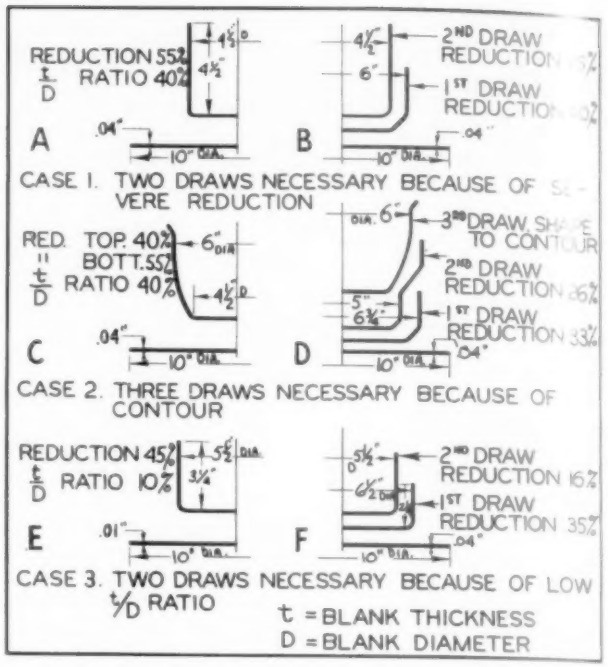


Fig. 44, showing three shells which would require redrawing for three different reasons. In case 1, a 10 in. diameter blank is to be drawn into a 4½ in. diameter shell. Here, the t/D ratio is reasonably high and should be good for a limit draw. The reduction shown at A is 55% and, since recommended practice for aluminum specifies not more than 48%, the arrangement shown would be much too severe for one draw. A more practical arrangement is shown at B, in which a first draw to 6 in. diameter reduces the blank 40%. A redraw of 25% then brings the shell to the required diameter of 4½ in. Case 2, a 10 in. diameter blank, to be drawn to a 6 in. diameter "shaped" shell is shown at C. The small diameter of the bottom of this shell creates a condition in which there is a substantial area out of control at the start of the draw if attempted in one operation. Shapes similar to this, in aluminum, must be drawn in two or more operations, and a suggested method is shown at D. Case 3, a 10 in. diameter blank to be drawn to a 5½ in. diameter shell is shown at E. The blank is .010 in. thick and the t/D ratio is quite low, necessitating a lower initial reduction. The reduction from 10 in. to 5½ in. is 45%, which is well within the 48% suggested as an outside limit for the common alloys of aluminum. However, it is too severe for a blank having a t/D ratio of .10, and a suggested method is shown at F.

Certain contours are difficult to draw because substantial areas are out of control, and extra draws are necessary to obtain wrinkle-free shells. Another condition which makes it necessary to redraw is a low t/D ratio. In such cases, the reduction percentage must be well below the 48% suggested as an outside limit for the non-heat-treatable alloys of aluminum, and while a t/D ratio of .40% may be good for a 48% reduction, this reduction of 48% would be much too severe for a blank having a t/D ratio of .10%. The 70% diameter-depth ratio mentioned earlier would probably be the top limit for one draw on blanks having a t/D ratio of about .40%, but blanks having a t/D ratio of around .10% would probably require more than one draw if the diameter-depth ratio was over 40% because blanks in this category cannot be given as great a reduction as those having a higher t/D ratio.

Figure 44 shows three shells which would require redrawing operations for three different reasons, as follows:

(1) Case No. 1 — When a limit draw of 48% or less will not reduce the blank to shell diameter in one operation.

(2) Case No. 2 — When the shape of the shell is such that too much metal will be out of control.

(3) Case No. 3 — When the diameter reduction of the first draw has to be reduced because of a low t/D ratio, all of the foregoing as explained in the caption.

Installment No. 6 will follow in November issue, The Tool Engineer.

By E. A. Ryder

Unilateral Tolerances for Drilled and Reamed Holes

Interchangeable manufacture demands closely held limits of tolerance

While only five basic classes of fits—running, push, driving, forced and shrinkage—are commonly recognized throughout industry, modern manufacture requires at least two additional classes—slip fit and interchangeable fit. The first five do not apply directly to mass manufacture, nor even directly to dimensions, although each may have close relationship with a mating part. The same holds for slip fit, a rather loose term which implies that a toolmaker use discretion when fitting mating tool components.

On the other hand, interchangeable fit is directly related to mass production and implies not only dimension but also definite boundaries over or under a dimension. For that reason, the manufacture of interchangeable parts, on a mass scale, requires that all parts be manufactured within closely held limits of tolerance, both as regards dimension and surface finish.

Two Terms Used

In turn, these tolerances are designated by two terms—unilateral and bilateral tolerances. Inasfar as it pertains to a basic dimension, the first implies that the total tolerance is in one direction only. The second term implies that the tolerance can be in both directions, over and under the basic dimension. Thus, if the nominal basic dimension be 2 inches, then unilateral tolerance would be expressed as 2.000 + 0.001 in. or as 2.000 — 0.001 in. whereas bilateral tolerance would be expressed 2.000 +/— 0.001 in. See Fig. 1.

While the foregoing is but indirectly related to the subject—Unilateral Tolerances for Drilled and Reamed Holes—it nevertheless serves to define tolerances and, therefore, to provide a clearer understanding of their functions and limitations. It is not ordinarily possible, in long-run mass production, to produce all parts exactly alike. A slight difference in stock hardness, wear of tools or grinding wheels, looseness in machine spindles, thermal expansion during machining, and even slight differences in measuring instruments are but a few of many factors tending to cause variations from a specified norm.

It may be stated, in this connection, that tolerances ordinarily incline toward the least dangerous side of mating components, and would therefore be unilateral in that direction. Where variation one way or the other could be equally dangerous or detrimental, then tolerances would be bilateral. As a rule, however, tolerances should be unilateral for mating surfaces or components, as shown in Fig. 2.

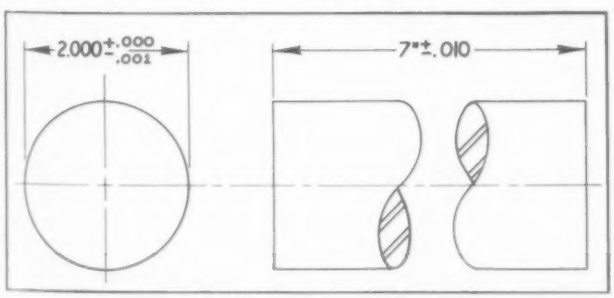


Fig. 1. The diameter—2.000 + .000 — .001 in.—is expressed as a unilateral tolerance in that it is all in one direction. The length—7 +/— .010—is expressed as a bilateral tolerance since the limits of tolerance can go in either direction.

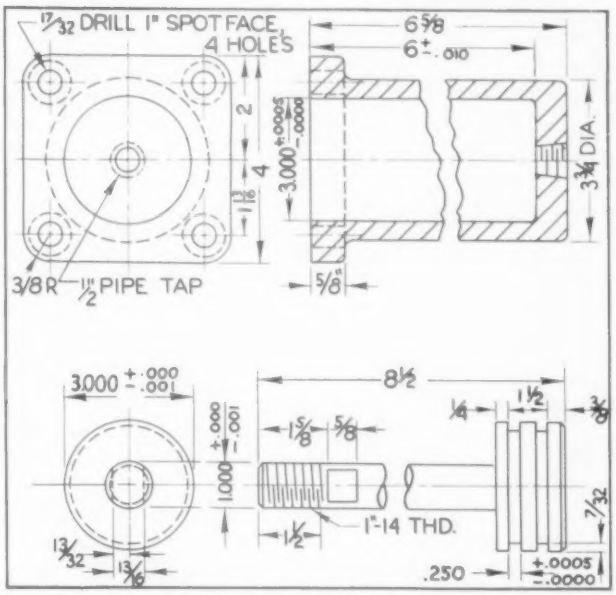


Fig. 2. An informal drawing designed to illustrate the difference between bilateral and unilateral tolerances rather than correct dimensioning. The two components shown are a cylinder and a piston, and naturally, the tolerances for each must be stated in the direction of least danger of interference when assembled. Therefore, the bore of the cylinder, and the diameter of the piston head and piston rod are each expressed as unilateral tolerance, plus and minus respectively. For purpose of assembly, the other dimensions are relatively unimportant, except that the piston ring grooves are also expressed in unilateral tolerance to insure fit of the rings in assembly. While it has no direct bearing on the subject, it might be stated that the flat on the piston rod is for wrench grip, when assembling a clevis or other fitting, to prevent scoring of the rod.

In the case of drilled and/or reamed holes, various conditions tend to create differences in hole sizes as well as surface finish. Feeding a drill too fast will result in rough hole surface and, in the case of a small drill, too fast a feed may cause it to deviate from a straight line, especially so if the bushing be disproportionately short. If a drill is ground off center, or with different angles of cutting lips, it will drill oversize, and if a large drill is shortened to stub length as a result of recurrent grinding, it may cut undersize because of the slight back taper.

A reamer may "climb" as a result of misalignment, when the hole will taper from the entering end, or it may cut large

TABLE 1. G-M-C STANDARDS

UNILATERAL TOLERANCES ON TWIST DRILLS

Up to 3/64 in. inc.	Minimum = nominal minus 0.0006 in.
Above 3/64 to 1/8 in. inc.	Minimum = nominal minus 0.00075 in.
Above 1/8 to 1/4 in. inc.	Minimum = nominal minus 0.0010 in.
Above 1/4 to 3/4 in. inc.	Minimum = nominal minus 0.0015 in.
Above 3/4 to 1 1/2 in. inc.	Minimum = nominal minus 0.002 in.
Above 1 1/2 to 2 in. inc.	Minimum = nominal minus 0.0025 in.

Maximum = nominal size in all cases.

Unilateral tolerances on standard and long-shank drills according to General Motors Corporation standards

TABLE 2.
UNILATERAL TOLERANCES ON REAMED HOLES

From Drafting Room Practice, Johns Hopkins Applied Physics Laboratory

Reaming on automatic screw machines:	Tolerances
Up to ½ in. diameter	0.001 in.
Over ½ to 1 in. diameter	0.0015 in.
Hand Reaming:	
Up to ½ in. diameter	0.001 in.
Over 1 in. diameter	0.002 in.
Machine Reaming:	
Up to ½ in. diameter	0.0005 in.
½ to 1 in. diameter	0.00075 to 0.001 in.
Over 1 in. diameter	0.0015 in.

Unilateral Tolerances according to Johns Hopkins Drafting Room Manual

as a result of uneven grinding of teeth. Hole surface may be rough as a result of too fast feed or scoring by chips clogging the flutes. In no instance will it ever cut smaller than its diameter across teeth; however, it may cut below specified limits of tolerance as a result of wear or recurrent sharpening.

Tolerances of drilled and reamed holes may therefore be expressed as either bilateral or unilateral, but are commonly expressed as unilateral. As for surface finish, it is rather difficult to arbitrarily state what is "rough" and what is "finish" surface; therefore, there is no pat figure which will cover all cases. A norm would have to be established to fit the individual case.

Industries Have Set Standards

As far as is known at time of writing, there have been no published standards specifically defining or confining tolerances for drilled and reamed holes in conjunction with surface finish. However, several of the larger corporations, and especially General Motors, have set up what are virtually standards under which suppliers must operate. Table 1 shows unilateral tolerances on regular and long shank twist drills as taken from General Motors Standards, page G-7, January, 1948.

Unilateral tolerances on reamed holes are shown in Tables 2 and 3, taken respectively from Drafting Room Manual, Section III, page 12, Johns Hopkins Applied Physics Laboratory, and from Curtiss-Wright Engineering Manual, Sec. 6, page 1.2, revision 6/1/43.

TABLE 3.
TOLERANCES ON REAMED HOLES

From Curtiss-Wright Engineering Manual

Reamer diameter, inches	Machine Reaming	Hand Reaming
No. 60 (0.040) to 0.499	0.0005	0.0010 in.
0.500 to 0.999	0.0010	0.0010 in.
1.000 to 1.999	0.0015	0.0020 in.
2.000 to 3.999	0.0020	0.0020 in.

Refer, also, to standards of Nat'l Screw Machine Products Association.

TABLE 4.
TOLERANCES FOR DRILLED HOLES

Compiled from random sources

From Drill size	Tolerance
From No. 60 to 30	0.0075 in.
From No. 29 to 1	0.001 in.
From ¼ to ½ in.	0.002 in.
From ½ to ¾ in.	0.0025 in.
From ¾ to 1 in.	0.003 in.
From 1 to 2 in.	0.005 in.

Table 3, at Top, is adopted from Curtiss-Wright Engineering Manual. Lower Table is set up from random sources.

Table 4 is compiled from various sources, including questions and answers from and to readers of The Tool Engineer, and is therefore informal although, to an extent, it is informative if not essentially authoritative. According to this information, hand-reamed holes—not included in the Tables—run from 0.0004 in., up to 1 in. diameter, to 0.0006 in. for holes over 1 inch, with tolerances slightly greater for machine reamed holes—that is, assuming that all teeth cut evenly.

TABLE 5.
RELATION OF SURFACE ROUGHNESS TO MACHINING TOLERANCES

Operation	Roughness Ranges, microinches rms‡	Commercial ranges of machining tolerances, in.*
Rough turn.	63 to 2000	0.001 to 0.010
Roughmill	63 to 1000	— —
Shape	32 to 500	0.005 to 0.010
Rough grind	32 to 250	— —
Finish mill	16 to 250	0.005 to 0.010
Smooth turn	8 to 250	0.002 to 0.007
Broach	8 to 125	0.0005 to 0.002
Commercial grind	8 to 63	— —
Finish grind	4 to 32	0.003 to 0.0015
Internal hone	1 to 16	0.0002 to 0.0003
Polish	0.5 to 32	— —
Superfinish	0.5 to 16	0.0001 to 0.0003
Lap	0.2 to 16	0.0001 to 0.0003
Sand castings	250 to 1000	0.03 to 0.125
Forgings	63 to 250	0.012 to 0.087†
Rolled surfaces	16 to 250	— —
Die castings	32 to 125	0.001 to 0.003§
Extrusions	16 to 250	— —

*Ranges derived from many sources; offered as approximately only
‡Data from Tool Engineers' Handbook
†Commercial thickness tolerances for drop forgings
§Tolerances within metal die

Table 5, showing relation of surface roughness to machining tolerances

For the smaller drills, tolerances would naturally be unilateral inasmuch as the drill would probably cut oversize, whereas bilateral tolerance might be stated for the large drills, depending on how far the drills are ground back from the original cutting points or lips, all as previously mentioned. It will be noted that tolerances shown in Table 4 vary considerably from those stated in Table 1, which may be considered the more authoritative of the two.

Conditions Determine Tolerances

As far as the relationship between surface finish and tolerances is concerned, the determining factor would be the operating conditions of mating parts. Thus, reciprocating parts—as a piston in a cylinder—would imply lapped surfaces for wear purposes as well as original fit; however, the actual relationship of diameters would depend on whether the assembly operates at low or high speed, and if hot or cold. Thus, the actual tolerance would have to be determined according to application. Table 5, which bears on relation of surface roughness to machining tolerances, has been compiled in part for publication in the Tool Engineer's Handbook. The first two columns are as they will appear in the Handbook, while the third column on tolerances has been derived from various sources. It is therefore suggested that not too much reliance be placed on correlation of this tolerance column to the surface roughness column. There are too many variables. Taken as a whole, however, this article conveys information on tolerances and surface finish as far as this has been compiled to date.

By James K. Matter

34-91040

Drilling 18-8 Stainless Steel

Correct drilling practise necessary to prevent work-hardening of material

By 18-8 is meant that particular type of corrosion resisting steel whose analysis shows approximately 18% chromium and 8% nickel. While the most common of the chromium-nickel alloys, possessing many desirable qualities, it is sufficient for the purpose of this article to state that it is an austenitic alloy and therefore work-hardens easily and rapidly.

After completing apprenticeship as machinist with Pennsylvania R. R., James K. Matter served as machine gunner in World War I. Later, graduated from Carnegie Tech, with Master's degree from Cornell, he held executive positions—as general manager and vice-president of Aluminum Products Company among others—with various manufacturing concerns. A member of Detroit Chapter, ASTE, he is presently connected with Pioneer Engineering and Manufacturing Company.

This property of work-hardening is not too well known generally and, because it presents problems in machining, we shall therefore elaborate on this point inasfar as it applies to drilling—a common yet important phase of metal processing since later operations are frequently located from the first drilled hole.

Drilling Small Holes in a Drill Press

Starting with small holes, since these are of first concern, the question arises: Will the holes be drilled in a jig, or will they be laid out by hand, prick-punched and drilled? If the hole is to be laid out and punched, then the conventional or center punches should be discarded since the cone shaped point wedges the material back on an angle and work-hardens the surface so that a small drill won't even start to cut. The point of the drill dulls immediately and, if pressure continues to be applied, the point will crumble and the drill break.

For this material, a center punch should be used with a point that is not a point, but a flat shaped like a triangle,

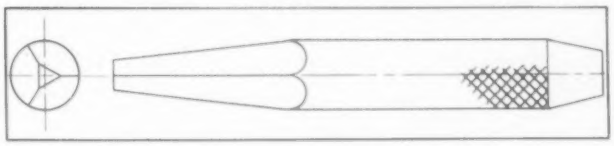


Fig. 1. Center punches for stainless steel should not have the conventional conical point; instead, should have a triangular point flattened on the end, as shown.

as shown in Fig. 1. In using this punch, it should be tapped lightly, so that the mark made will be no deeper than necessary. If struck too hard, the steel will work-harden and the drill point will refuse to pierce the surface.

If drilling is to be done in a jig, the jig should be designed so that the bushing is held as short as possible, as illustrated in Fig. 2. The alloy is tough to drill; therefore, drills should be kept to as short a length as possible since long drills tend to whip and flex, and eventually break off.

Whether the hole is drilled in a jig, or drilled free, it is important that the material be backed up, as shown in Fig. 3, because it does not chip or break out ahead of the drill point, as in the case of ordinary steel. The material must be drilled through. If the hole is not backed up, the drill will tend to grab and break off on emerging.

High speed steel drills are always recommended, with the cobalt type first choice; however, if this proves to be too brittle, then the job must be done with the tungsten type. So far, it has not been practically possible to adapt the carbides to tipping small twist drills. Carbon steel drills are not suited for this material, and neither Stellite nor the other cast alloys seem to be applicable to the small drills. That confines choice to drills fabricated from high speed steel alloys.

Special Drill Types and Modifications

Since 18-8 is difficult to drill, at its best, conventional drilling practice—as applied to usual steels—does not hold with this material. And while high speed drills are recommended, as previously implied, the usual and familar forms must be changed or, at least, considerably modified. For

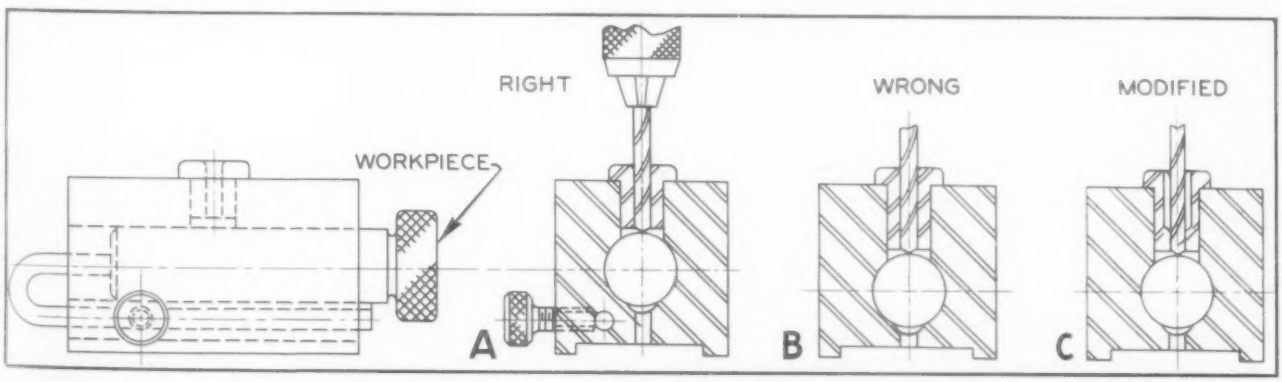


Fig. 2. Drill jigs for stainless steel, of which a simple type is shown at A, should be provided with short drill bushings, as suggested at B. The bushing shown at C would be too long; however, it can be relieved, as shown at C. Because the material is tough, drills should be short since long drills tend to flex and, therefore, will eventually break.

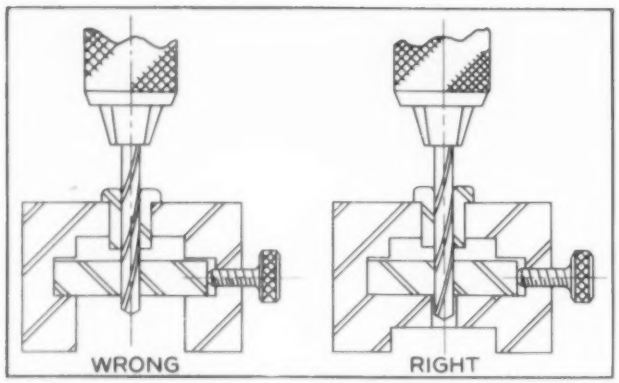


Fig. 3. Stainless steel does not chip or break out ahead of the drill, as in the case of ordinary steel. Rather, the material must be drilled through and, if the work is not backed up, the drill will tend to grab and break off on emerging. The "right" and "wrong" method is shown at left and right, respectively, the former suggesting proper backing for the workpiece.

instance, the usual 118° included point angle should be changed to 140°, as illustrated in Fig. 4.

It is especially important that all drills be ground properly —preferably in a drill-pointing machine or a special fixture— and the edges stoned afterward. Regardless of personal skill, no man can consistently grind small drills to secure proper clearance angles, point angles, correct clearance and the other factors necessary to compete with a machine ground product.

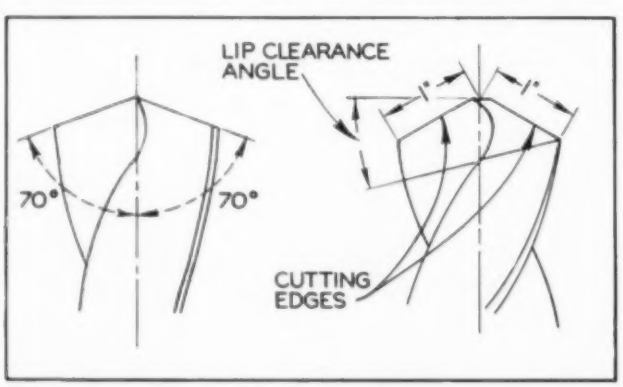
Lip clearance should be between 9° and 12°, and the two cutting edges must be equal in length and angle, as illustrated in Fig. 5. Drilling speeds of 18-8 range from 30 to 90 surface feet per minute, and feeds should be from .002 to .004 in. per revolution for drills up to ¼ inch in diameter.

It is important to keep small drills running at their top speed since, if this is not done, drill breakage will be high; also, all drills must be "backed out" occasionally to relieve chip packing and congestion. A rule-of-thumb practice is to drill three or four times the diameter on the first bite, two diameters on the second bite, and one diameter from then on.

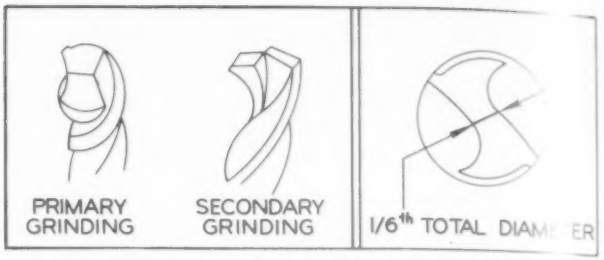
"Hole Riding" Hardens Material

One point to remember is: After clearing the hole of chips, the drill should not be permitted to "ride the hole" in one spot, or it will work-harden the metal immediately. A common fault that breaks many drills is the practice operators have of returning the drill to the bottom of the hole, and then throwing on the feed. While feed is being engaged, the drill scrapes on the bottom of the hole and work-hardens the metal. Then, the drill won't cut through the hard surface.

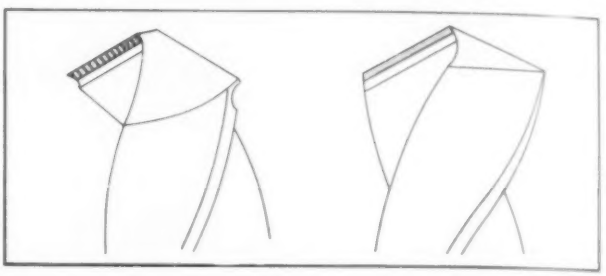
Correct procedure is to return the drill to a point close to the bottom of the hole, and then engage the feed. When the drill reaches the metal it starts to cut immediately. For average drilling in this material, most drill manufacturers now make a "stainless steel drill" having a shorter flute and overall length than regular drills. It is also somewhat heavier and more sturdy.



High speed drills are recommended for stainless steel; however, the usual 118° angle should be changed to 140°, as shown in Fig. 4, at left. Also, lip clearance should be between 9° and 12°, and the two cutting edges must be equal in length and angle, as shown in Fig. 5, at right.



For exceptionally deep holes, the standard crankshaft drill is recommended. The point angle should be 140°, but the lip clearance angle should be only 9°. As a secondary grinding operation, the heel edge of the drill point should be ground away, as shown in Fig. 6, left. Also, webs should be thinned as much as possible, usual practice being to thin web to one-sixth of the total diameter, as suggested in Fig. 7, at right.



To break up chips, when drilling large holes, chipbreakers may be ground in front of and below each cutting edge at the point, as shown in Fig. 8. Feed should be constant at all times.

Drilling Large Holes

Most of the things said about small hole drilling applies equally well to the drilling of large holes. On some of the larger sizes, Stellite-tipped drills are available which have certain advantages over high speed steel drills. It is often found desirable, in drilling these alloys, to break up the chips. This may be accomplished by grinding a chip breaker in front of and below each cutting edge at the point. This type of groove is shown in Fig. 8. With either large or small drills, it is important that a constant feed be maintained at all times.

Cutting Fluids

While there are many recommended cutting fluids available today, for use in drilling this alloy, the water soluble oils are the cheapest and, if used in the heavier mixtures, give satisfactory service on many jobs.

If, however, the water soluble oils do not work out on a job, then the logical procedure is to turn to one of the sulphurized base oils. The tougher the job, the more sulphurized oil is needed. But, since the various oil companies have their own brands developed for special service, their recommendations should be considered for any definite applications.

By Joseph Kim

Fundamentals of Job Shop Scheduling

Short-run jobs demand close scheduling for maximum machine utilization

USUALLY BUT FEW ITEMS, if any, are manufactured in large quantities in job shops. As a result, the process time required for any given product may vary from 1 to 100 days; furthermore, many jobbing contracts specify definite shipping dates and carry a penalty clause for nonfulfillment, all of which complicates production and material control problems.

A native Hawaiian, Joseph Kim received his B. S. at Antioch College, followed by a course in business administration at Harvard University Graduate School. Trained in chemical engineering, production and factory management, he is now engineer on special assignment on the General Manager's Staff, Bendix Products Division of Bendix Aviation Corporation. Among other technical societies, he is member of South Bend Chapter, ASTE.

A multiplicity of short-run jobs demand a close scheduling system for maximum machine utilization and reasonable in-process inventory. Unfortunately, no single system can be universally applied to all job shops, but, there are certain fundamentals that can be applied in the development and installation of a system for a given company. This paper suggests an approach to the problem of developing a scheduling system for a job shop.

Fundamentals of a Scheduling System

The basis of scheduling a job shop is fundamentally the same as that of any other. First, it is necessary to have some sort of a routing sheet specifying the sequence in which operations are to be run. Several methods are used throughout industry. Some merely state the part number—or parts list if necessary—the operation numbers in sequence, and the machines involved. Others, more elaborate, include information describing the operations in detail and specifying the exact machine, as well as all tooling, fixtures and gages required. Usually, the estimated time for the performance of the operation is given, either in pieces per hour or in terms of standard hours—as, for example, time required to machine 100 pieces.

Second, it is necessary to make a load analysis on all machines available, particularly on single purpose types. In this analysis, the problem of versatility of equipment should be considered, so that, in the event one machine is overloaded, the work can be routed to another. In the manufacture of large parts such as a landing gear, for instance, the job might originally have been routed over a Cincinnati Hydrotel; however, it might be possible to perform the same operation on a large horizontal mill with some minor adaptations. See Figs. 1, 2 and 3, which show typical charts.

In making this analysis it is necessary to use a machine utilization factor. This factor must be applied to groups of machines, rather than to the shop as a whole. For instance, a factor of 80% might be used for the drill press section, whereas on the mills it might be 50%. There is no empirical rule for arriving at this factor, which is dependent primarily upon experience; therefore, the information must be furnished by production supervision.

Once the load has been established, the manpower requirement must be analyzed, using the necessary efficiency factor to arrive at a true picture of the actual number of men required. It is assumed that the number of shifts and days worked in the week has already been determined.

Construction of a Flow Chart

The next step is to examine critically the products that are to be manufactured and to construct a flow chart showing the process time required for a single or series of given assemblies. The steps to be used in the construction of a flow chart are as follows:

MACHINERY	STANDARD HOURS	TOTAL SETUP HOURS	TOTAL OF SETUP AND STANDARD HOURS	FACTORED TOTAL HOURS	NUMBER OF MACHINES AVAILABLE
BAKER HORIZ	65	9	74	163	1
3 AL GISHOLT	50	7	57	125	3
2 L GISHOLTLG BD	149	50	199	438	2
BARNES BORE DR	30	7	37	81	1
BARNES BORE					1
EXCELLO					1
CONSOL MILL	11	21	32	70	1
G AND L 5					1
G AND L 4	1	3	4	9	1
FOX 2 WAY	16	3	19	42	1
OIL GEAR BROACH	1	5	6	13	1
1 SPINDLE DRILLS	1	1	2	4	3
5 CARLTON	134	79	213	469	10
314 BAKER	65	20	85	187	4
SNYDER CENTER	16	13	29	64	1
BAKER INVERTED					1
BAKER 36HO	2	3	5	11	1
4 SPDL EDLUND	37	11	48	106	1
6 SPDL EDLUND	167	74	241	530	2
50 HEALD					1

Fig. 1. Sample section of an I.B.M. (International Business Machines, Inc.) scheduling chart. The diagonal lines at top have been added to clarify the several columns of figures. The factored hours represent the load against the particular machine in question. It also varies with the product involved.

LEAD TIME CHART FOR THE MANUFACTURE OF PLUNGERS

OP.	MACHINE	5	10	15	20	25
5	ARBOR PR.	X X X X				
10	LEAK TEST	X X X X	1/4 MAN			
15	PRESSURE TEST	X X X X	1/4 MAN			
20	DEGREASE	X X X X	1/40 MAN			
30	MASK	X X X X	1/2 MAN			
35	SPRAY	X X X X	1/2 MAN			
40	BAKE	X X X X	3/4 MAN			
45	HEALD ROTARY	X X X				
50	HEALD ROTARY	X X X				
53	4-SPDL. L & G	X X X X X				
55	HEALD INT.	X X X X				
60	EXCELLO BORE	X X X X				
63	BURR	X X X X	1/8 MAN			
70	BRYANT INT.	X X X	X X X X X X X X X X		6-MCH	
75	INSP. & CODE	X X X	X X X X X X X X X X		2-MAN	
80	LAP	X X X	X X X X X X X X X X X X			

Fig. 2. Lead time chart, as set up for the manufacture of plungers. The operation sequences, and name of corresponding operation, are shown together with the fractional man-time and machines involved.

(1) The parts, or groups of related parts that require the longest machining time are selected; (2) the lot size must then be determined; (3) the time, including setup, required to perform each operation in sequence is calculated; and (4) by dividing the time allowed for each operation by the number of machine hours available per day, and pyramiding these days, a chart is constructed.

The actual lot size to be used must be determined by the ratio of total setup hours to total machining hours and the length of time, after receipt of initial customer's orders, before shipment is required. In cases where the ratio of setup hours to machining hours is high, and the time allowed for initial shipment is short, two charts should be constructed, one to meet the first shipment and the other for normal operations.

The basis for determining the number of days to be allotted to each operation must be the same as those used in the original load analysis. For example, if a factor of 80% was used for machine utilization, and a factor of 50% for labor efficiency, then a factor of 40% overall efficiency must be used. The total machining time is multiplied by 2.5 and divided by the total number of hours available per day.

These days are added consecutively to determine the overall process time required. This is a tacit assumption that lots are to be run through one operation before another is started. The reason for planning in this manner is to allow for manufacturing contingencies. In actual practice, of course, a series of operations can be run concurrently if the rates of operation are such that one operation can feed another.

For flow chart purposes, however, it is unwise to plan on the basis of running operations concurrently because, unless a shop has excess capacity, all the machines needed for this kind of operation may not be available at that particular time. Furthermore, concurrent operations often make it difficult to keep a given lot intact, especially if repairs are necessary, and the reason for drafting the chart in terms of days is to enable one to determine quickly the day on which the initial operation must be started to meet a given shipment date.

It is difficult to decide which part should be selected for charting purposes as, here again, it is dependent upon the length of time required for the machining process, and also upon the ease with which it can be manufactured. When the system is first introduced in a shop, it is best to chart as few parts as possible and merely to specify the dates on which piece parts used in sub or main assemblies must be finished. This lessens the confusion usually associated with the introduction of a new system.

Steps in Drafting a Schedule

The starting date for the manufacture of a part is determined by counting back from the shipping date the number of working days required. Starting from the initial operation, then the dates when each operation is to be started and finished are specified. Also specified should be the dates when piece parts are needed in the manufacture of a major part will be needed. The responsibility of seeing that these parts—and all parts not shown on the flow chart or scheduled in detail—are produced, must rest with the assignment or follow-up man, or with the foreman.

In setting up a schedule it is important that a cushion be provided at intervals of five to ten days to allow for tool trouble. The finishing dates of the parts, or series of parts, should also be set back from that normally required, to provide for emergencies that may develop. The actual amount of cushion to be used can be determined with the cooperation of shop supervision, but it is highly important that it be incorporated.

After making out detailed schedules for all the major units that are to be manufactured, they must be grouped and reviewed as a whole to determine whether machinery conflicts exist. For instance, if only one boring mill is available, it should be obvious that only one operation can be performed at a given time. By judiciously juggling schedules it is possible to resolve all conflicts.

When it is impossible to resolve such conflicts, then outside sources should be lined up to help break the bottleneck. Quite often, much can be done by examining each operation to see whether it could not be run on another machine by making minor changes in the setup. For while a schedule is not a substitute for manufacturing judgment, it will permit efficient operation when used intelligently.

Personnel Requirements

The development of any form of schedule presupposes a knowledge of the product and shop practices involved. The man doing the scheduling should know equipment and machinery, and must be able to resolve any conflicts that might develop. Should need arise, for example, it is possible to do turning operations on a turret lathe as well as on an engine lathe; similarly, engine lathes can be used for boring purposes.

Usually, it is best to select someone who has had shop experience within the organization. This is especially true in the case of a large shop—say one employing 300 or more in a single division where many different types of machines are used. It must be recognized, however, that men with practical shop knowledge alone might be ill-suited from an educational standpoint to take over the functions of schedules; therefore, a training program should be developed.

Dispatching or Assigning

A schedule is only as effective as the dispatching or assignment organization that is set up for its execution. In some companies, it might be possible merely to give the schedule *in toto* to the foreman and have him do his own dispatching. In other shops, where there are many men and a variety of manufacturing equipment under the supervision of each foreman, it is necessary to install an assignment system which assigns work to the individual machines.

The task of assignment is a joint function of the foreman and dispatcher, and the effectiveness with which a depart-

Op	Machine & Size	Fixture	Hrs.	5 pieces April S	F	5 pieces May S	F	5 pieces June S	F	5 pieces July S	F	5 pieces August S	F	5 pieces September S	F	5 pieces October S	F	5 pieces November S	F
				(A)															
80	Snyder	Std	2	4-13	4-13	4-23	4-23	5-24	5-24	6-23	6-23	7-24	7-24	8-24	8-24	9-23	9-23	10-23	10-23
81	Snyder	Std	2	4-13	4-13	4-23	4-23	5-24	5-24	6-23		7-24		8-24		9-23	9-23	10-23	10-23
82	Count																		
83	Norton Gap	69677-F-6 & 7	12	4-14	4-14	4-24	4-26	5-25	5-26	6-24	6-25	7-26	7-27	8-25	8-26	9-24	9-25	10-25	10-26
84	Count																		
85	Inspect		1	4-15	4-15	4-26	4-26	5-26	5-26	6-25	6-25	7-27	7-27	8-26	8-26	9-25	9-25	10-26	10-26
95	Sandblast		10	4-15	4-15	4-27	4-27	5-27	5-27	6-26	6-26	7-28	7-28	8-27	8-27	9-27	9-27	10-27	10-27
100	Cad plate		10	4-15	4-16	4-28	4-28	5-28	5-28	6-28	6-28	7-29	7-29	8-28	8-28	9-28	9-28	10-28	10-28
105	Inspect																		
115	Magnaflux		5	4-17	4-17	4-29	4-29	5-29	5-29	6-29	6-29	7-30	7-30	8-30	8-30	9-29	9-29	10-29	10-29
120	Wash		2	4-17	4-17	4-29	4-29	5-29	5-29	6-29	6-29	7-30	7-30	8-30	8-30	9-29	9-29	10-29	10-29
123	Count																		
125	Final Inspect		1	4-17	4-17	4-29	4-29	5-29	5-29	6-29	6-29	7-30	7-30	8-30	8-30	9-29	9-29	10-29	10-29
135	Prime		1	4-17	4-17	4-29	4-29	5-29	5-29	6-29	6-29	7-30	7-30	8-30	8-30	9-29	9-29	10-29	10-29
140	Count																		
DD	Stores			4-17		4-30		5-31		6-30		7-31		8-31		9-30		10-30	

Fig. 3. A production-shop schedule which could be used in place of, or in addition to, the charts shown in Figs. 1 and 2. This schedule shows the operation number, the machine, fixtures involved—if any—and the total hours allotted for the particular operation. "S" signifies the starting date and "F" the finishing date. This is an example of shop scheduling, by operations, used in manufacture of landing gear.

ment operates is dependent upon the degree of cooperation between the production foremen and the assignment men. Both are interested in producing the right part at the right time.

A number of methods can be used in dispatching. One is a card-assignment system where each operation is listed on one card, and these cards are sent to the proper department where the assignment man or foreman loads his machines. Others use the McCasky System, and some depend merely upon the judgment of the assignment man who looks at the schedule made out by the scheduling section and, from it, determines when each operation should start.

Follow-Up

Once having established the scheduling and assignment systems, some sort of a follow-up system should be instituted by which to judge performance. Some companies find it best to use follow-up men whose duties are to check the progress of work through the shop against a given schedule. Others employ a visual follow-up system using a production control board on which the shop progress is projected daily, with the necessary information supplied either by waybilling or dispatching cards properly filled out by the foreman or assignment man.

This information, relating to the progress which is being made against a schedule, should be made available to the scheduling division. This is essential because the scheduling division usually is divorced from the shop; therefore, the factors—efficiency, machine utilization, and other factors that are being used in the drafting of schedules must often be revised. The obvious inference is that, in the event the shop has constantly failed to meet the schedule, the difficulty might be due to the improper factor being used. Furthermore, this gives management a check on the efficiencies in the various departments.

In the case where a contract is obtained on a fixed price basis, and the job is bid upon a pre-supposed efficiency, it permits management to revise their estimates before a new contract is accepted. In many cases, provisions are included in original contracts that enable manufacturing to pass on additional costs to the customer. This is especially true when additional work is required because of engineering changes instituted after the contracts were placed.

Summary

The essential thing to remember, in the installation of a scheduling system in a job shop, is that each product must be considered first as an individual unit, and then in relation to the rest of the items being manufactured. And what may be true in one department in the matter of efficiency and machine utilization, may not be true in another; therefore, the scheduling of each department must be considered separately. It is imperative, when installing a new scheduling system, that the initial schedules be realistic. Too often a system is discarded because of minor difficulties that were encountered in its introduction.

Before any system is released to the shop, shop supervision should be fully informed as to the intent and purpose of the new system and given the right to reject any schedule before it is actually released. It must be pointed out that the system is being installed to aid production and that it is their responsibility to see that it works.

An Interesting Setup for Automatic-Cycle Stud Welding

Shown here is an interesting application of stud-welding in connection with units used for petroleum processing. Up to four studs per minute are permanently affixed in an automatically controlled welding cycle initiated by the pull of the trigger of the stud-welding gun.

Of interest is the carriage running on tracks, one of which is "veed" for parallel travel. Operation is in a straight line, the tank being rolled for each line of studs. The work shown is being done at the General American Transportation Company. Photo by courtesy of Nelson Stud Welding Division, Morton-Gregory Corporation.

Chart for Linear Expansion of Materials

This data on Linear Expansion of Materials has been compiled by Acme Industrial Company, Chicago, to whom we are indebted for courtesy of reproduction. *The Editors*

NOTES ON LINEAR EXPANSION

The table on the opposite page is based on a coefficient of linear expansion of .0000066" (6.6 micro inches) per degree Fahrenheit per inch length, which is an average value for hardened carbon steel and the low alloys. This value was selected since hardened steel is most often used for precision work. Although the chart is intended primarily for hardened steel, it can be used approximately for 11 grades of carbon steel and the low alloys, whether hard or soft.

For stainless steel, it is very important to know whether the steel in question is of the 18-8 class, or whether it falls into the group which contains chromium but no nickel. The difference in expansion can be seen from the list below which shows that the 18-8 type has a coefficient of approximately 1½ times that of carbon steel, while the type without nickel expands 10% to 15% less than carbon steel.

For other materials, the list below gives the coefficient of expansion and correction factor for the chart. The coefficients given are an average for the various materials; however, they are sufficiently accurate for most engineering and manufacturing purposes. Should an exact figure be required a careful laboratory determination of the particular material in question would be necessary.

COEFFICIENTS OF LINEAR EXPANSION

(Coefficient in Inches per Degree Fahrenheit per Inch Length)

MATERIAL	COEFFICIENT	FACTOR*
Silver	.0000108	1.63
Aluminum	.0000123	1.86
Brass	.0000096	1.45
Bronze	.0000099	1.50
Cast Iron	.0000056	.85
Copper	.0000089	1.35
Glass	.0000040 to .0000050	.61-.76
Lead	.0000157	2.38
Steel, carbon and low alloys	.0000061 to .0000073	.92-1.1
Steel, stainless		
18-8 type	.0000096	1.45
12 to 15% chromium	.0000057	.86
16 to 18% chromium	.0000058	.88
Tin	.0000127	1.93

**For materials other than hardened steel, multiply figure from body of expansion chart by this factor to correct for difference in coefficient of expansion.*

See Opposite Page for Expansion Chart

EXPANSION CHART FOR STEEL

Change in size of Steel* parts with variations of temperature (Based on coefficient of linear expansion of .0000066″ per °F. per inch of length)

See opposite page for discussion of application of table.

DIMENSION of PART	TEMPERATURE VARIATION IN °F									
	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°
1/16	.000002″	.000004″	.000006″	.000008″	.000010″	.000012″	.000014″	.000017″	.000019″	.000021″
1/32	.000003	.000006	.000009	.000012	.000015	.000019	.000022	.000015	.000028	.000031
1/8	.000004	.000008	.000012	.000017	.000021	.000025	.000029	.000033	.000037	.000041
3/16	.000006	.000012	.000019	.000025	.000031	.000037	.000043	.000049	.000056	.000062
1/4	.000008	.000017	.000025	.000033	.000041	.000049	.000058	.000066	.000074	.000083
3/8	.000012	.000025	.000037	.000049	.000062	.000074	.000090	.000099	.000111	.000124
1/2	.000017	.000033	.000049	.000066	.000083	.000099	.000115	.000132	.000149	.000165
5/8	.000021	.000041	.000062	.000083	.000103	.000124	.000144	.000165	.000186	.000206
3/4	.000025	.000049	.000074	.000099	.000124	.000149	.000173	.000198	.000223	.000247
7/8	.000029	.000058	.000087	.000115	.000144	.000173	.000202	.000231	.000260	.000289
1	.000033	.000066	.000099	.000132	.000165	.000198	.000231	.000264	.000297	.000330
1 1/4	.000041	.000083	.000124	.000165	.000206	.000247	.000289	.000330	.000371	.000413
1 1/2	.000049	.000099	.000149	.000198	.000247	.000297	.000347	.000396	.000445	.000495
1 3/4	.000058	.000115	.000173	.000231	.000289	.000347	.000404	.000462	.000520	.000577
2	.000066	.000132	.000198	.000264	.000330	.000396	.000462	.000528	.000594	.000660
2 1/4	.000074	.000149	.000223	.000297	.000371	.000445	.000520	.000594	.000668	.000743
2 1/2	.000083	.000165	.000247	.000330	.000413	.000495	.000577	.000660	.000743	.000825
2 3/4	.000091	.000181	.000272	.000363	.000454	.000544	.000635	.000726	.000817	.000907
3	.000099	.000198	.000297	.000396	.000495	.000594	.000693	.000792	.000891	.000990
3 1/4	.000107	.000215	.000322	.000429	.000536	.000643	.000751	.000858	.000965	.001073
3 1/2	.000115	.000231	.000347	.000462	.000587	.000693	.000809	.000924	.001039	.001155
3 3/4	.000124	.000247	.000371	.000495	.000619	.000743	.000866	.000990	.001114	.001237
4	.000132	.000264	.000396	.000528	.000660	.000792	.000924	.001056	.001188	.001320
4 1/4	.000140	.000281	.000421	.000561	.000701	.000841	.000982	.001122	.001262	.001403
4 1/2	.000149	.000297	.000445	.000594	.000743	.000891	.001039	.001188	.001337	.001485
4 3/4	.000157	.000313	.000470	.000627	.000784	.000941	.001097	.001254	.001411	.001567
5	.000165	.000330	.000495	.000660	.000825	.000990	.001155	.001320	.001485	.001650

By H. J. Chamberland

Lubrication Extends Band-Saw Life

Oil-Mist Lubrication Effects Marked Economies in Metal Cutting

With all metal-cutting tools, the cutting oil or compound used is effective only if directed at the point of contact at the instant of cutting. While various lubricating methods have been resorted to in connection with band sawing, research engineers have come to definitely favor the spray system. The feature of spray lubrication is that the lubrihant is forced under pressure—usually 30 to 40 pounds—directly into the saw teeth as they enter the work. The resultant rapid dissipation of heat prevents chip clogging and effects a substantial increase in tool life and cutting rate. The lubricating attachment, designed especially for vertical type band saw equipment, is readily fitted to any specialized band saw or contour sawing machine.

H. J. Chamberland **is an old-timer in manufacture, with about 25 years practical experience in production and tool work. A versatile writer, he is author of some 400 articles on various phases of manufacture.**

Using a high-grade soluble oil diluted in 40 parts of water, with air usually available from any standard air-pressure line and with metering valve set as low as possible, the lubricant actually mists or vaporizes with a consumption of less than 12 ounces per hour. To this add cleanliness of work and machine table as contributing factors toward efficiency and economy.

Although the spray lubrication system is highly effective when cutting alloy steels at conventional velocities, it is by far more effective in relation to high speed band sawing where drip lubrication at its best is of little value. Although spray lubrication gives excellent results with high-speed sawing of many non-ferrous metals,—and especially some types of plastics and liminates where friction between blade and work softens the materials to a plastic state—the greatest benefits are attained in the sawing of light metals.

Dry Cutting Vs. Spray Lubrication

As a means of establishing a reasonably dependable estimate of blade cost per square inch, when cutting aluminum dry and with a lubricant, the test piece consisted of an extruded bar 3¼ in. square, type 17 ST and of 100 Brinnel hardness. This test was conducted on a high speed machine equipped with hydraulic table feed, with 3 pitch 1 in. wide buttress type blading operating at 3000 f.p.m. The lubricant used was a mixture of 1 part of a processed soluble oil —such as No. 470—to varying parts of water, forced di-

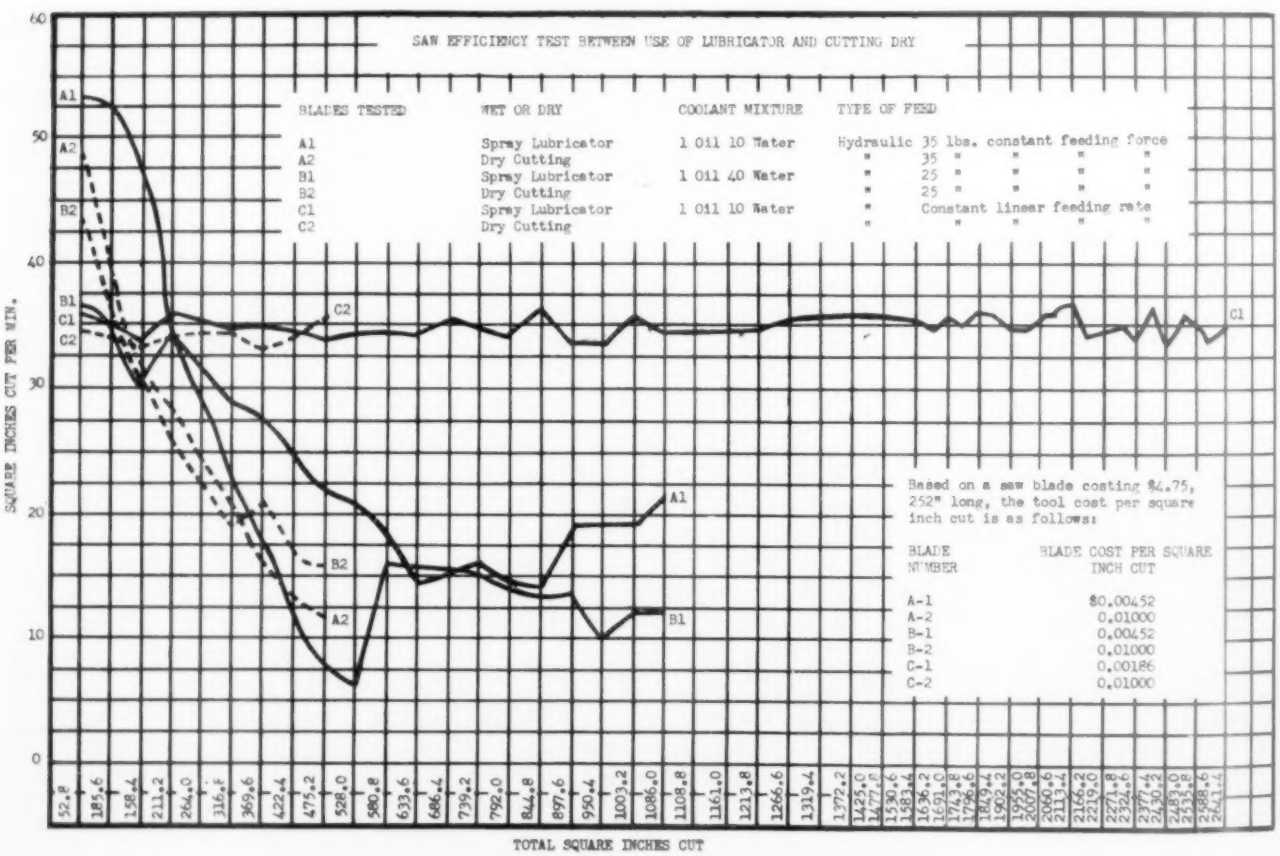


Chart showing the comparative effects of lubricated vs. dry cutting. The lubricant was used on blades A1, B1 and C1, using 50 lbs. air pressure. The cuts made by these blades are shown by the solid lines. Blades A2, B2, and C2, which were run dry, are indicated by the broken lines. While the graph shows the sharp cutting rate increase on blades A1, A2, B1 and B2 at different points of test, this was due to applying increased feeding pressure when trying to check the rapid drop in cutting rate.

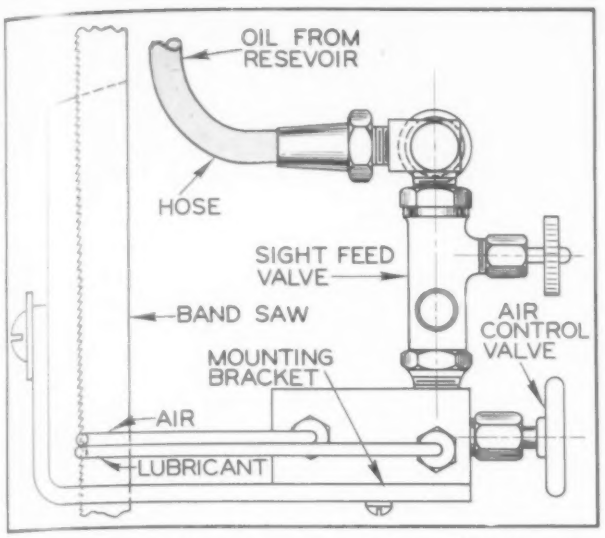


Diagram showing the workings and application of the spray-lubrication system. The lubricant is delivered to mixing valve from the reservoir, via hose as shown. A sight feed provides a visual check on the flow of oil. Air, entering through an inlet at the back of the valve—not shown—is metered by the air control valve. Oil and air both emerge from the ends of the small tubes, shown lying parallel just over the mounting bracket, where the oil is atomized and directed to the teeth of the saw blade.

rectly to teeth-work contact point at the rate of 120 drops per minute by the spray method.

As shown on the accompanying graph, the lubricant concerns blades A1, B1 and C1, using 50 pounds air pressure. The cuts are shown by solid lines. Blades A2, B2, and C2 —run dry—are shown by broken lines. The graph readily shows the sharp cutting rate increase, at different points during the test, on blades A1, A2, B1 and B2. This is caused by applying added feeding pressure when trying to check the rapid drop in cutting rate.

Blade failure was determined the moment each saw showed a cutting rate far below normal, or when saw lead reached ⅛ in. With blades A1, A2, B1 and B2, the hydraulic pressure was regulated to provide a constant feeding force while, on the other hand, adjustments were made for blades C1 and C2 to produce a constant lineal feeding rate.

Noting the different types of feeds used, the question arises as to what the results would be if the feeding pressure was increased on blades A and B as cutting continued. Obviously, results would be quite the same as obtained on blade C providing that the feeding pressures were gradually increased. However, the test definitely proved two facts: first, that it is imperative that the saw teeth be kept heavily engaged in the work since, otherwise, short saw life will result, and second, that proper lubrication does materially increase both saw life and cutting rate.

For a basis of analysis as to the value of a lubricant as applied to aluminum, it is proper to proceed in terms of blade cost per square inch cut and project this cost to equal the number of square inches obtained under most efficient sawing conditions. The following comparisons show the savings effected:

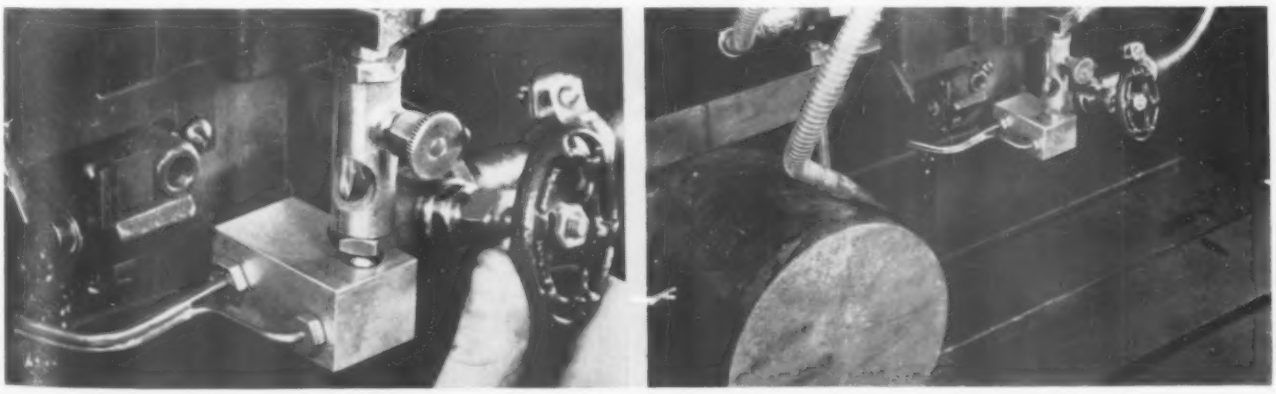
> Saw C1 cut 2641.4 square inches at blade cost of $4.75, when using lubricant. Saw C2 cut 2641.4 square inches at blade cost of $26.41, using no lubricant. Therefore, savings attributed to proper lubricating procedure equals $21.66.

It should be agreed that a cutting oil or coolant is a "must" to reduce tool cost. What many fail to do, however, is to investigate which is which and how it can be used to greater advantage. It is well to consider that, in the course of research which has given industry several economical choices of general-purpose tool steels, similar progress has meanwhile been achieved in processing soluble oils that, when mixed in correct proportions, will efficiently solve at least 75% of most industrial metal cutting problems. While the No. 470 soluble oil previously referred to was developed particularly with saw band life in mind, it is performing exceptionally well with drilling, reaming, threading and milling, and also as a grinding coolant where high surface finishes are imperative.

Variation In Saw Life

A saw test to determine tool life requires ample material for conclusive facts and figures and, depending on the type of material and thickness involved, the variation in saw life may vary from one to possibly five and even more hours. A test may be conducted on the basis of how many square or cubic inches the saw will cut before it begins to lead, or to determine the ultimate wear-resistant qualities of the teeth and how long it will actually cut. For example, one of the saws used in a recent test on 1 in. steel cut 1,170 square inches before it started to lead, yet actually cut 1717 square inches before it was scrapped.

Saw tests may also be conducted on a short cut basis—that is, by setting a certain period of cutting and comparing wear of width, set and gauge of blade with original dimensions. Saws of this type have been known to last 18 hours, cutting 75 square inches during this period and losing but 0.005 in. on the set, 0.006 in. on the width and only 0.0003 in. on the gauge. Any marked increase in cutting efficiency between hardened teeth saw bands is in greater part due to their respective heat treating techniques. The longer life saws are uusually those showing absolute control over tooth hardness depth precisely at the gullet line.



The spray lubricator applied to a band-sawing machine. In the photograph at left, the operator's hand is shown adjusting the air control valve. The air hose, which was not shown in the line drawing above, is here visible at the rear of the valve. The photograph at right shows how the curved oil and air pipes are joined and bent to suit installation. Photos by courtesy of the DoAll Company, Des Plaines, Ill.

By Frank W. Curtis

Single Vs Multi-Turn Induction Heating Coils

While having limitations, single-turn coils are applicable to a wide range of work

Single-turn induction heating coils suit a wide variety of applications, as may be required for hardening and silver-alloy brazing. While they are often preferred, because of their simplicity, they do have limitations, based on the diameter and the length of the area to be heated. High-frequency current follows the path of least impedance, and will not spread out to cover a wide band. It is this phenomena that dictates whether a single- or multi-turn coil should be used.

Relationship Varies With Size

The relation between the diameter and the height of a single-turn solid-type coil varies somewhat with size. A small coil, as at A, Fig. 1, can be made with a height equal to its diameter, and will produce uniform heat to a steel shaft placed within, because the current is concentrated to a comparatively small coil area. With a larger coil, as at B, the height of the coil should not exceed one-half of the diameter. As the coil opening increases, the ratio is reduced, so for a 2-in. coil, as at C, a normal maximum height would be ¾ in. For a coil 4 in. in diameter, the maximum height should not exceed 1 in. In fact, a 1-in. height is about maximum for any single-turn coil.

When a narrow band is to be heated, as at A, Fig. 2, a single-turn coil is well suited. As the length of the heated area increases, as at B, a two-turn coil is better, whereas for longer areas, as at C, a multi-turn coil is always preferred. There is, too, a limit to the length of a multi-turn coil beyond which the distribution of heat becomes uneven. Usually, when the length of heated area exceeds two to three times the diameter of the work, progressive heating should be considered, depending on the diameter of the work and the output power of the high-frequency generator.

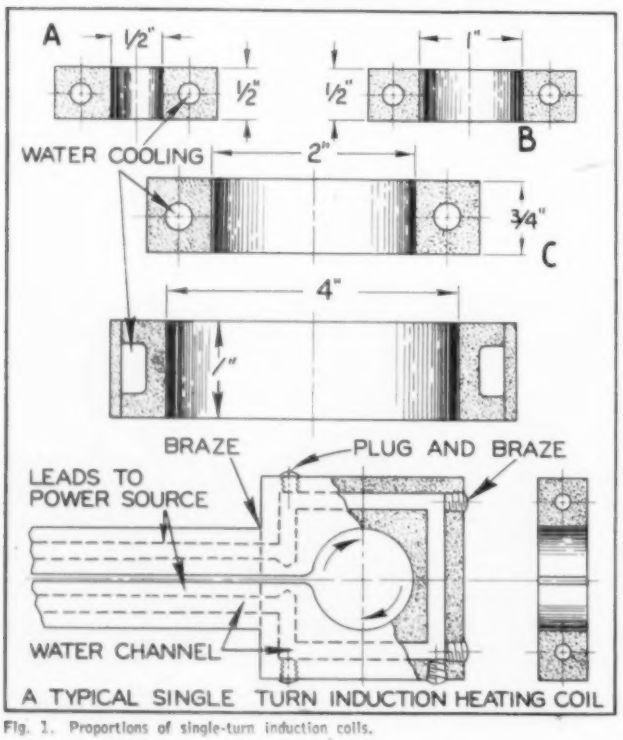


Fig. 1. Proportions of single-turn induction coils.

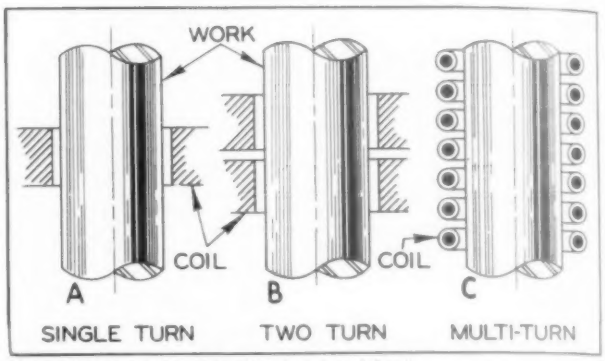


Fig. 2. Selecting coil type in relation to heated length.

Size of Work Determines Coils Used

The gear at A, in Fig. 3, is proportionately correct for heating with a single-turn coil. The gear at B, however, could not be uniformly heated with a single-turn coil, because the current might only circulate around one portion of the coil. For this gear a multi-turn coil, as at C, is essential. The example at D shows a multi-turn coil, with flattened turns for gear hardening, preferred when spray-quenching is applied immediately following the heating portion of the cycle.

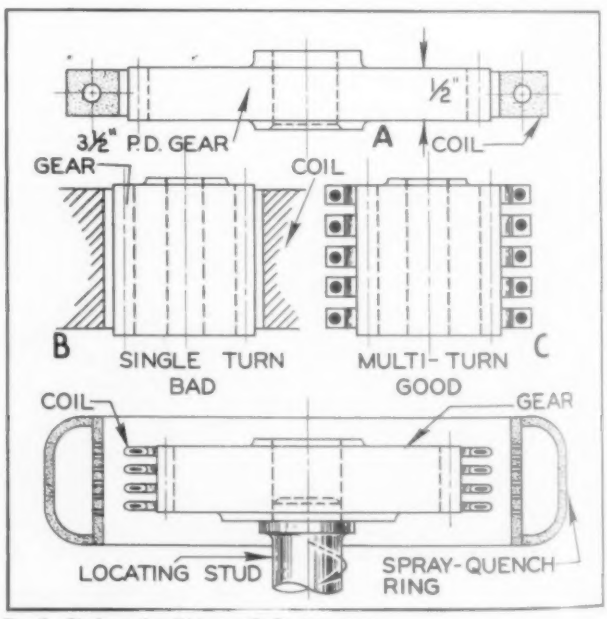


Fig. 3. Single- and multi-turn coils for spur gears.

34-91000

Tools for Boring Operations

By A. E. Rylander

Installment No. 3 of a Series

Given a rigid machine and a rigid yet free-running spindle, together with the corollary condition that the workpiece be solidly held and that the cutting tool have a minimum of spring, it may be said that the most accurate boring is done with a single-point tool held in a stub boring head. This is true whether the work or the tool rotates—with, perhaps, some bias in favor of the latter because it may be the easier balanced.

However, stub tools are mainly confined to short or blind holes, and therefore have their limitations. For long open holes, or for in-line boring of identical or different diameters, piloted boring bars are used. These may combine facing, chamfering or undercutting tools and, in rare instances, even threading tools.

The most elementary tools, for boring, are the plain forged and the inserted-bit bar, used for boring operations on engine lathes. The latter is commercially available in several standard types although all are designed to be gripped in a holder which, in turn, is held in the lathe tool post.

In this bracket may also be included the plain boring head, designed for use in rotating spindles, all as shown in Fig. 13. Shown in Fig. 14 are two of a number of types of commercially available, standardized boring heads with micrometer adjustment. Tools of this type are designed for precision production boring, or for use with jig borers.

Trend Toward Precision Borers

While precision boring can be done on practically any machine having a rotating spindle or driver—such as a drill press, boring mill, engine or turret lathe, milling machine or independent power unit—the trend in recent years has been sharply toward machines especially designed for boring. As a rule, these machines are build up from standard units; thus, it is possible to provide single, double or multiple head machines for special purposes that are yet flexible enough to be modified for seasonal product changes. Typical examples are shown in Fig. 15.

Apropos precision boring on "practically any machine", this depends largely on tool design, as implied above. For example, it may be required, although not necessarily desired, to precision bore a workpiece on a drill press having

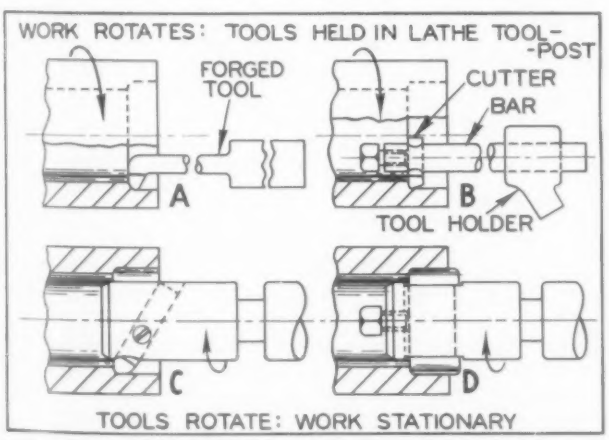


Fig. 13. Typical plain boring tools. A and B are lathe boring tools, the one a forged tool, the other a bar with inserted bit. C and D are stub boring heads, the former taking an inserted single-point bit, the latter a 2-edged cutting blade.

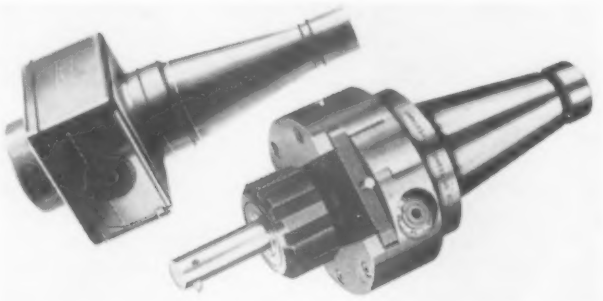


Fig. 14 shows two typical commercial adjustable stub boring heads designed for use on production boring or with jig boring machines. The tool at left is by Wendt-Sonis, of Hannibal, Mo., the one at right by Universal Engineering Company, Frankenmuth, Mich. Both have micrometer adjustment.

inordinately loose spindle bearings. But, the machine has sufficient power for the purpose, and will therefore serve as a driver for a boring bar. By designing a fixture with pilot bushings, and by interposing a flexible coupling between the spindle and the boring bar, all as shown in Fig. 16, one should be able to do accurate boring with a machine so tooled.

One consideration, here, is that accuracy is mainly dependent on the fit between the boring bar—or its pilot—and the pilot bushings. But here we have the condition that, in the course of a day's run on high production, a boring bar may expand from heat. Thus, if it is a close running fit at the start of a run, when cold, it may later expand enough to seize in the bushings. And if allowance is made for this expansion, it will be too loose at the start of the run for accurate boring.

Under any set of conditions, allowance must be made for running fit of a bar in its bushings, and however slight this may be, it will nevertheless be sufficient to preclude the ultra-precision attainable with the rigidly held stub boring head in combination with a precision boring machine. This does not mean that precision boring cannot be done with piloted bars; it does mean, however, that the greater number of elements involved all tend, however slightly, toward accumulative errors.

However, the fit between bar pilot and bushings may be made not only close but practically constant by resort to rotary bushings running in precision, pre-loaded ball bearings, as shown in Fig. 17. These bushings, incidentally, are commercially available in standard sizes and may be further lined with standard plain drill bushings for sustained accuracy.

The particular advantage of these rotary bushings is that, as the bushing rotates at the same speed as the bar, there is little if any heat generated by friction. There is only sliding wear to contend with—a rather negligible factor considering the slow forward motion of the feed and the faster although comparatively slow traverse on withdrawal of the tool.

Of course, these bushings are mainly applicable to high production boring, or where spindle speeds are too high for

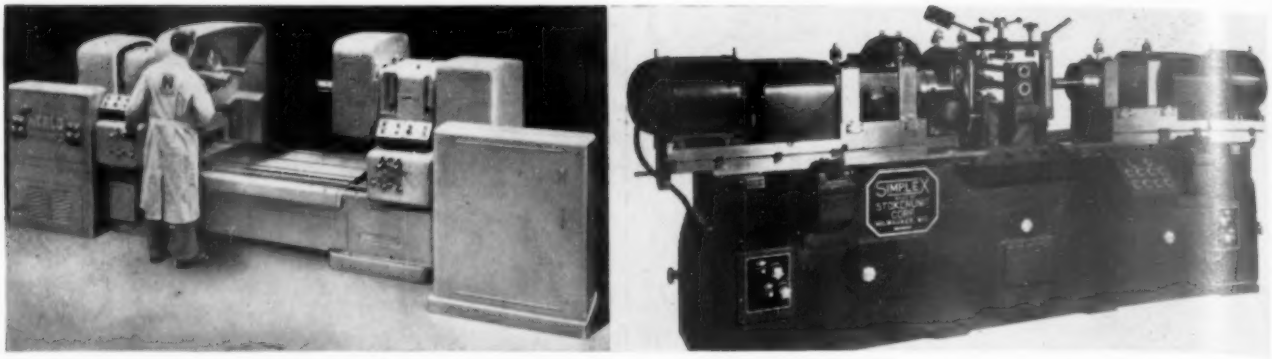


Fig. 15. Typical precision boring machines. The machine at left is a double-end Bore-Matic, by Heald Machine Company, Worcester, Mass., and the 3-head machine at right is a Simplex by Stokerunit Corporation, Milwaukee, Wis. Both machines are designed for precision boring of large work-pieces. Note that while stub boring bars predominate, the lateral bars on the Simplex are piloted in the fixture. Facing tools may be incorporated with the bars.

practical use of plain bushings. It is not implied that they are necessary for short-run boring at low spindle speeds; under such conditions, one may attain required accuracy with pilots running in plain bushings.

While a discussion of fixtures may seem to be a deviation from the subject of cutting tools, the fact is that, in precision boring, the cutting tools, boring bars or heads, fixtures and machines are all closely integrated. And no matter how "right" any one of these elements may be, precision would suffer if at least two of the remaining three were defective. The cutting tool itself must be right, and the boring head or bar as well, but as for the machine or the fixture, one or the other must be right. Preferably both, although not necessarily so.

Boring bars provide an interesting study in themselves and, because they are so diversified, warrant at least one article devoted to their design and functions. We will therefore devote the next installment entirely to boring bars and their application to various jobs.

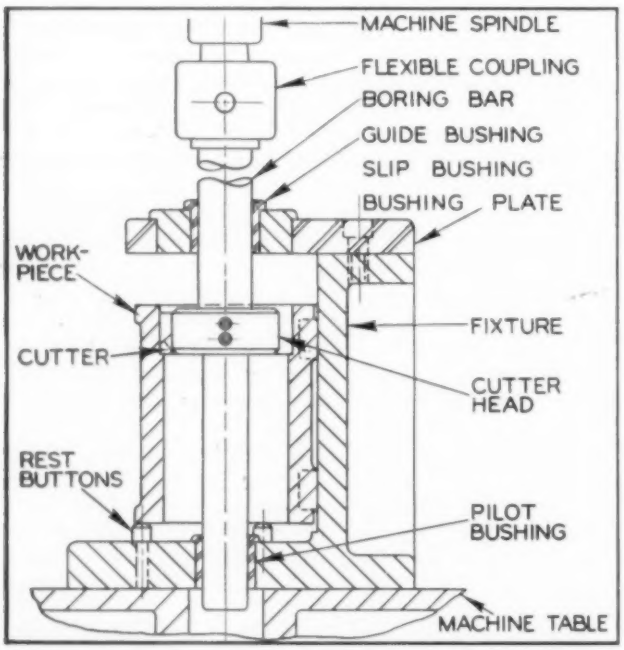


Fig. 16. Suggested design of fixture for accurate boring on a machine—such as a drill press—having a loose spindle. The workpiece used for purpose of illustration is an open-end cylinder provided with mounting feet. Clamping is not shown, being incidental to the theme. The cutting tool is held in a cutter head, which is pressed on the bar and shouldered above the cutter head to take thrust. The bar is piloted both ends, with a flexible coupling interposed between the bar and the spindle; thus, the bar has practically perfect alignment regardless of spindle play. Note that the upper guide bushing is held in a slip bushing of larger diameter than the bore of the workpiece so as to permit passage of the cutter head. As the bar is retracted the cutter head lifts up the slip bushing, the whole thereby clearing the fixture for unloading and loading.

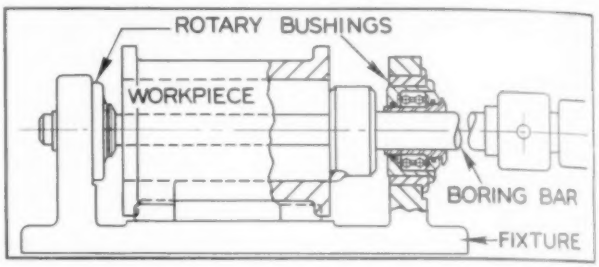


Fig. 17. A boring fixture, for use with a horizontal spindle machine, incorporating rotary pilot bushings. For purpose of easier comparison with the plain bushings shown in Fig. 16, the workpiece and general setup are practically identical. The rotary bushings permit a close fit on the bar and, as there is little if any heat generated because of friction between the bar and the bushing, to cause expansion of the bar, fit between the two remains practically constant and assures more accurate boring over sustained intervals of time.

Installment No. 4 will follow in November issue.

London (England) Aug. 31.

Technical Editor,
The Tool Engineer

Dear Sir:

I read with interest your article "An Introduction to Cutting Tools" on p. 59, The Tool Engineer, August 1948, as well as your (Andygrams) in which you stress the study of the fundamentals.

Your grandfather was certainly right and it is only to be regretted that he did not get into contact with your draughtsman who drew the Fig. 1 of your article. This man does not seem to have had any workshop experience as he has drawn the clearance at the wrong side and quite unrelated to the work. If he had had any knowledge of fundamentals he would know that point angle plus clearance plus rake angle always adds up to 90 degrees and this mistake would not have occurred.

Yours faithfully,
P. Grodzinski

While Mr. Grodzinski is technically right, Fig. 1 referred to was purposely distorted to show increasing clearance as the work decreases in diameter. For that reason the tool was drawn without end relief, and the "clearance" shown ahead of the vertical line. To have shown it otherwise would have spoiled the illusion. The draftsman is therefore absolved, and blame, if any, centers on

The Technical Editor.

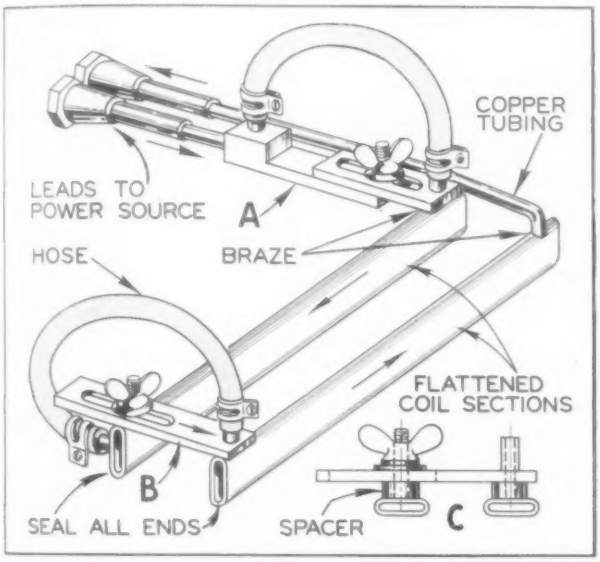
GADGETS

Ingenious Devices and Ideas to Help the Tool Engineer in His Daily Work

Readers in general, and members especially, are cordially invited to submit ideas which may suggest short cuts in manufacture or which may be directly appended to some specific tooling problem. The Tool Engineer will pay $5.00 and up for accepted contribution to our Gadget pages.

Induction Heating Coil Made Adjustable

A parallel-type induction heating coil of the single-turn design, as used with progressive feeding setups, can be made variable by the addition of an adjustable lead and a jumper. The adjusting feature provides for differences in the rate of heating, either faster or slower, as may be required to compensate for other variables, such as a change in the size of the workpiece being processed, the rate of the feed, or the output power of the generator. All coil parts are made of copper, either from the tubing or flat bar stock.



An induction heating coil with adjustable features, suited to such progressive feeding setups as might require soldering, brazing or hardening.

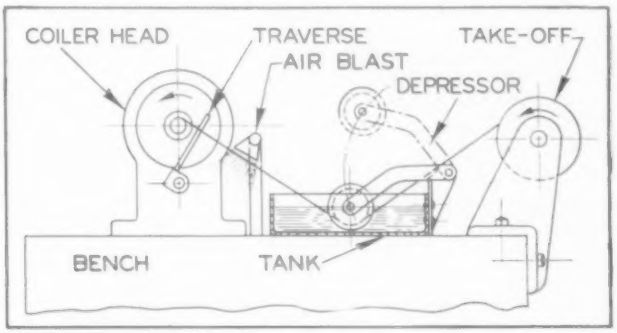
The adjustable lead, A, has an internal water connection, through a rubber hose, to provide for the flow of cooling water to one of the flattened coil sections. The jumper B provides continuity of current between coil sections, while another length of rubber hose is used for the circulation of water. All fixed joints of the coil are brazed to insure good electrical conductivity and flow of current in the direction of the arrows.

To set the parallel coil sections wider apart or closer together, the two wing nuts first are loosened, the spacing adjustment then is made, and the wing nuts again tightened. The coil sections shown are made of flattened copper tubing, the ends of which are sealed to prevent water leakage. The tubing could be assembled as at C if a narrower heating band were required. This sectional view also shows how the use of spacers can be added to raise the height of the jumper for additional clearance as may be required to suit different sizes of workpieces. Square copper tubing, or solid coil sections with drilled holes, can be used if preferred.

C. W. Frank

Coiling Enamel Coated Wire

A company making an instrument which required a coil of fine wire wound around a 1/16 in. square core had difficulty with the enameled insulation flaking off from the wire due to the sharp initial bends, causing shorts in the wound coil. After various kinds of insulation had been tried, the trouble still continued. Either the insulation cracked on the outer radius in winding, or it scaled off on contact with the sharp corners of the core.



The fine, enamel-coated wire runs through a pan of hot water, being held immersed by a roller depressor. A blast of hot air, between the pan and the spooler head, dries the wire and maintains the heat, which softens the insulation so that it does not flake off as a result of severe bending.

The problem was solved by running the wire through a tank of hot water, located between the take-off spool and the coiler head. An air nozzle, located between the tank and the coiler traverse, blew a blast of hot air on the wire, drying it and also maintaining heat.

The heat softened the insulation, making it not only sufficiently plastic to take the sharp bends without cracking, but also stretching it on the outer radius so that it no longer flaked off. Speed of production went up considerably with only occasional rejects.

E. A. Ryder

To Remove Broken Stub Shafts

A stub shaft, that may have broken off flush with a blind hole, may be removed by drilling and reaming a comparatively small hole in the stub until it breaks through at the opposite end. Size of the hole should correspond with standard drill rod size. After reaming, fill the hole with heavy oil or light grease, insert a length of drill rod and strike with a hammer. The oil, compressing into a solid, will force out the stub. Repeated blows may be necessary.

Should this fail, then gunpowder may be rammed into the hole until the chamber behind the stub is nearly full, and set off with a fuse. That will work!

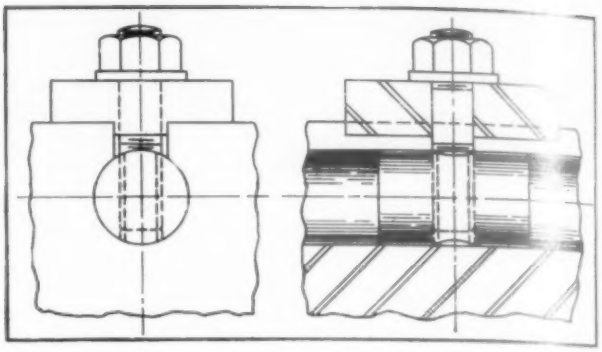
Either method has the advantage that it may be used without dismantling a machine and having to mount the part in a lathe for removal by boring.

Round Tee-Slots

Having occasion to build a fixture in a hurry, and not having immediate recourse to a milling machine with which to mill a T-slot, and with little time in which to make a slotting tool for use in a shaper, a toolmaker hit on the idea of drilling and reaming a hole in the base plate and cutting a parallel slot opening into the hole. The general idea is shown in the drawing.

The T-bolt, in turn, consisted of a short length of 6 R. S. rod tapped for a stud and dressed down to a sliding fit in the reamed hole. The "T" member was subsequently case-hardened. While the idea is not generally recommended as a substitute for the conventional T-slot, it has the feature of versatility and adequate strength for the purpose used.

Courtesy of "Verkstäderna"
Sweden.



To make this T-slot, a hole of adequate size is drilled and reamed in the base plate. A slot is then milled into the hole. The T-bolt is made from a C.R.S. bar, same size as the hole, or slightly smaller, and tapped for a threaded stud.

Rotary Drill Jig Features Simple Design

A "rotary" type drill jig, for drilling eight 13/32 in. holes and four 3/8 in. holes in a controller vane—shown in Fig. 1—features simple design and equally simple construction. The base of the jig, which consists of two end pieces joined by a plate, is turned and faced from one casting which is later parted to make two identical parts. The divided bushing plate is also machined in a lathe and is tongued sliding fit into the base members, as shown by the inset detail.

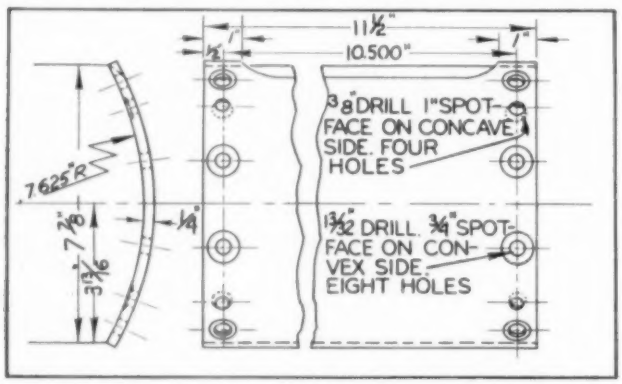


Fig. 1, a controller vane in which eight 13/32 in. holes and four 3/8 in holes are to be drilled. The holes are spotfaced "free" after removing from the jig.

The outside and inside radii of the base members and the leaf—or bushing plate—are respectively finished to the radius of the workpiece. Locating or indexing holes in the leaf end pieces, which are joined by a shouldered spacer rod, correspond with the radial location of the drill bushing holes. A knurled plug serves as index pin. The leaf is locked by means of conventional leaf screws, all as shown in the drawing of the jig, Fig. 2.

To operate, the leaf is swung back and the part is laid on the curved ends of the base. The part is located between six pins, as shown. The leaf is then clamped down and two opposite holes drilled; from then on, the bushing plate is progressively indexed until all holes are drilled.

Robert Mawson
Providence, R. I.

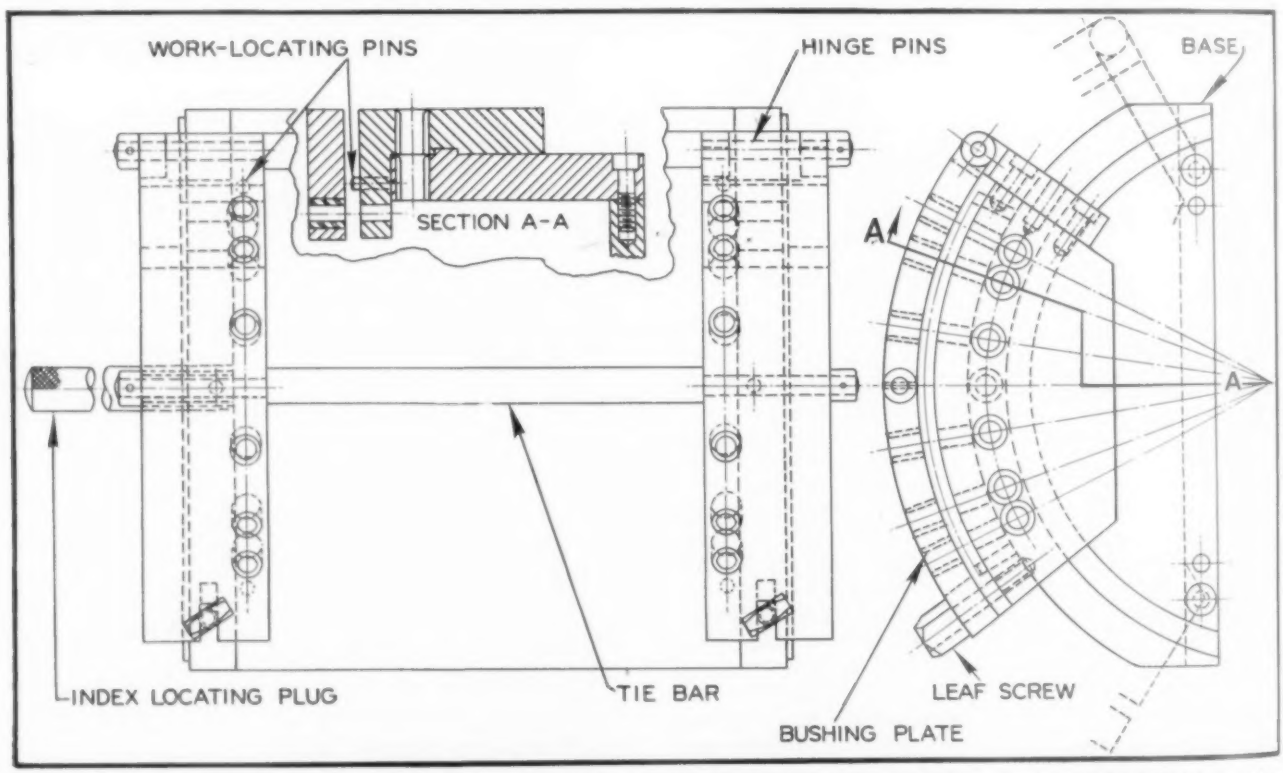


Fig. 2. The drill jig. The base end members are machined from one casting, which is parted in a later operation to make two identical parts. A spacer plate joins the two members. The bushing plate—or leaf—is also machined in a lathe as are the two sliding members, the latter grooved sliding fit on the tongued base end pieces. Index holes, corresponding with the radial location of the drill bushings, provide for progressive indexing of the several holes.

Society To Invite Membership To Write and Present Technical Papers

New Plan for Correlated Program Activity Announced

ASTE MEMBERS will participate to a greater extent in future National and Chapter meeting programs and the entire membership will enjoy better service through a plan of correlated technical session activity being developed jointly by the National Public Relations, Program, Education, and Editorial Committees of the Society.

E. W. Baumgardner

F. W. Curtis

H. B. Osborn, Jr.

H. F. Owen

Among other benefits expected from the proposed arrangement are: well-balanced programs, a source of editorial material for *The Tool Engineer* in line with ASTE objectives and professional requirements, a wider educational medium, and increased Society prestige.

Conferring recently at Detroit, H. B. Osborn, Jr., Public Relations Chairman, E. W. Baumgardner, Program Chairman, H. F. Owen, Education Chairman, and F. W. Curtis, Editorial Chairman, laid the groundwork for the new setup, in discussion with R. B. Douglas, First Vice-President, Guy Hubbard of the Editorial Committee, and H. E. Conrad, Executive Secretary.

Will Seek Qualified Speakers

Technical programs, the group agreed, must feature qualified men in the profession, preferably from the ranks of Society membership. Procedure will be to solicit and actively promote contributions of manuscripts on subjects falling within the classification of tool engineering.

Certain papers will be selected for presentation at technical sessions held during national meetings and will appear in *The Tool Engineer*. Other qualifying manuscripts will be chosen for exclusive publication in this periodical.

As outlined, the basic program for ASTE conventions will consist of plant tours in the morning, two concurrent technical sessions in the afternoon—each comprising approximately four papers, with no special activity scheduled for evening, except the annual or semi-annual dinner.

To assist potential technical paper authors, Mr. Douglas appointed a special committee to draft an instruction booklet on how to prepare papers. Serving on this committee are Mr. Osborn, Mr. Baumgardner and Mr. Hubbard.

The booklet is to include suggestions for presentation, a brief summary of the objectives, and a short explanation of common practices in abbreviating and annotating such manuscripts.

Also contemplated is a breakdown of tool engineering classifications by subjects, fundamentals for putting technical information into writing, reviewing and revision, and a sample outline of a typical article.

Further, the brochure will contain data on types of illustrations needed—charts, photos, drawings and diagrams; physical requirements for manuscripts submitted, and an outline of the processing of papers after they are received at the ASTE Central Office.

Suggestions on Slanting Articles

Other sections will include a manual of style, information on submitting an outline for criticism and slanting before writing an article, and an offer of assistance in shaping up a paper for oral presentation and on preparing slides.

Besides helping to improve the editorial contents of *The Tool Engineer*, the pamphlet will point out, authors of published technical papers will feel a satisfaction in seeing their work in print where thousands can use it for reference, and in advancing the purposes of the Society.

AMERICAN SOCIETY OF TOOL ENGINEERS

1666 Penobscot Building

Detroit 26, Michigan

Please send me complete information on the ASTE 4½ percent Building Fund Participation Certificates. (See "Our Society," Page 45.)

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High Production Efficiency Seen in Carburetor Plant

St. Louis, Mo.—How extremely efficient manufacturing methods, fully utilizing time and motion study and quality control, are employed to meet a high production rate was observed by 247 St. Louis tool engineers who visited the Carter Carburetor plant September 2. The large attendance was limited to ASTE members.

The visitors saw a battery of die casting machines forming carburetor bodies, tops, and fuel pump parts. Banks of Kingsbury units perform as many as 35 operations per cycle. For facing carburetor bodies, special Kingsbury machines of the company's own design are used.

Of especial interest to the engineers were carbide drills, boring in excess of 300,000 holes before requiring resharpening.

Many Operations Automatic

In the screw machine department, automatic pick up and replacing from one station to another, for side drilling and tapping, has many applications. Several machines are tooled to pick up a part, process it, turn it end to end and insert it in a tube conveyor leading to another machine where the piece is taken up mechanically, properly located, and finished.

Tooling in the drill press department is designed to enable the operator to handle three or four spindles, the worker performing only loading and unloading operations. Functions of the spindles and fixtures are entirely automatic, utilizing solenoids and air.

In carburetor production, it is necessary to watch for burrs, chips and slivers hidden in holes and crevices of the part. Consequently, deburring is done throughout the plant, using hand burring or tumbling after most of the machine parts are finished. This assures a 100% clean carburetor at the test line.

One of the largest and most complete in the area, the tool room includes all conventional equipment, besides Keller duplicating machines for contour milling in producing die casting dies.

After seeing how Carter's 3400 employees turn out 450,000 carburetors per month, the engineers watched the manufacture of mechanical and electric fuel pumps. Electric motors for some of the latter are also made in the plant. Battery powered, the motors are completely enclosed and operate in the gas tank.

Prior to the plant visit, 117 members gathered at the Fairgrounds Hotel for dinner and a business meeting.

Weaver Promoted

Springfield, Mass.—James R. Weaver has resigned as Works Manager of the East Springfield Appliance Div. plant of Westinghouse Electric Corp. to take charge of manufacturing at the Philadelphia plant of Baldwin Locomotive Works.

Mr. Weaver his directed production of the appliance plant for the past four years. His new appointment follows the recent purchase by Westinghouse of a stock interest in the locomotive company.

A former president of ASTE and a Springfield, Mass., Chapter member, he has been associated with Westinghouse in various plants and capacities for the past 35 years, except for a period of active naval service during World War I.

Other News In This Issue

Eacock Named Assistant To ASTE Executive Secy.

Detroit, Mich.—John S. Eacock, formerly of Montebello, Calif., has been appointed Assistant to Executive Secretary, ASTE, H. E. Conrad, Executive Secretary, has announced. Mr. Eacock succeeds Charles J. Hasse, former Office Manager at the Detroit headquarters.

He comes to the Society with extensive experience in accounting and administrative positions with nationally-known concerns.

A native of Indianapolis, Ind., Mr. Eacock was educated in the public schools of Lafayette, Ind., and received his accounting training from International Correspondence Schools, LaSalle Extension University and Wayne University.

Recent associations include Houde Engineering Div. of Houdaille-Hershey Corp., Buffalo, N. Y.; N. A. Woodworth Co., Ferndale, Mich.; Warner Manufacturing Co., Glendale, Calif.; Weber Showcase and Fixture Co., Inc.; Los Angeles, Calif.; and special accounting and tax work.

He is a member of Controllers Institute of America, Inc., National Association of Cost Accountants, National Association of Foremen, American Legion, and several fraternal organizations.

Mr. Eacock is married and has two daughters. He will make his home in Detroit.

Edwards, Michigan Rep.

Detroit, Mich.—Clyde Edwards, until recently Detroit area representative for Gatco Rotary Bushing Co., is now Sales and Service Engineer for the entire Michigan territory, James B. Giern, Company President, has announced. The firm was formerly known as Giern & Anholtt Tool Co., Inc.

Mr. Edwards is a Detroit Chapter ASTE member.

Left: A neighborhood "sidewalk superintendent" (center) oversees excavating for footings of new ASTE building in Detroit's Northwest section. Right: Everybody works but this passerby as construction progresses. Next page, left: Walls are up and roof trusses in place by early September. Right: At this stage the finished effect begins to be apparent. (By press time the roof was on and the concrete floor poured.)

Mid Hudson Conducts Tool Design Courses

Poughkeepsie, N. Y.—Two courses in Tool Design are being presented by the Education Committee of Mid-Hudson Chapter in conjunction with the Poughkeepsie Board of Education. The program, as outlined by Ellis Thorp, Education Chairman, was endorsed by the Chapter Executive Committee at its September meeting.

Course I is a fundamental study of jig and fixture design and will run for the entire school year. Basis of the course and text to be used are the Jig and Fixture Design books issued by the American Society of Tool Engineers in collaboration with the New York State Vocational and Arts Association. Principal requirement for enrollment in this course is a working knowledge of mechanical drawing.

Arranged for the advanced tool designer and engineer, Course II will cover specialized subjects such as Brown & Sharpe automatics and tooling, broaching, and blanking dies. As planned, eight sessions of two-hour duration will be allotted to each subject. When practical, time will be divided between class room discussion and plant visitation, where the subject involved may be studied in actual operation.

Instructors are specialists in the subjects to which they are assigned, recruited from the Chapter and from local industries, and licensed by the State Board of Education.

Each class meets for a two-hour period two evenings per week, in rooms provided in the local high school by the Board of Education. Courses are open both to ASTE members and non-members.

Curry Transferred

Hartford, Conn.—John J. Curry, a Hartford Chapter member of long standing, has been transferred from the office of Resident Manager of the Meriden Plant, New Departure Div. of General Motors Corp., to that of Resident Manager of the Sandusky, Ohio plant.

Mr. Curry has been active in Hartford Chapter activities and has served on the Chapter's Executive Committee.

Our Society

By HARRY E. CONRAD, *ASTE Executive Secretary*

Although I have asked several people, I am still looking for a simple explanation as to why one gets so much enjoyment and satisfaction in being a so-called "sidewalk superintendent." All I know is that I manage somehow to pass our new building project on the way to work in the morning and again on the way home at night and there has even been the occasion when I have found logical reason to take someone out there during the day.

Almost anytime during the day or night, it is not at all uncommon to see several members who are also doing a little "sidewalk superintending."

The whole project from the time of acquisition of the property to the clearing of the land, to the laying of the footings and right on through to the present stage of putting on the roof has all been a process of intense interest and satisfaction.

Structure Is Symbolical

To me, and I know to many others, the building represents much more than a pile of brick, mortar, concrete and stone—it is even more than a symbol of a principle. There is something very much alive represented in this building—it seems to have a spirit which is involved in the history of the Society and, at the same time, represents today as well as going forward into the future in such a fundamental way that the mere sight of it gives one a warm feeling of satisfaction and security.

I feel assured that every member of the Society senses the same reaction and I am sure that all of us will get a real thrill when we see the new structure completed.

Interest on the part of the membership and the Chapters is running at a high level, in that a large number of requests have been sent in for information on the 4½ per cent interest bearing Participation Certificates. It was the hope of the Building and Financing Committees, as well as the Directors and Officers, that the response to the Participation Certificates would be widespread throughout the membership. It is indeed gratifying to be able to report at this time that this hope has materialized in an exceptionally concrete manner.

This evidence on the part of the membership wanting to participate in this activity is another proof positive of the spirit that is within this organization that has made it great.

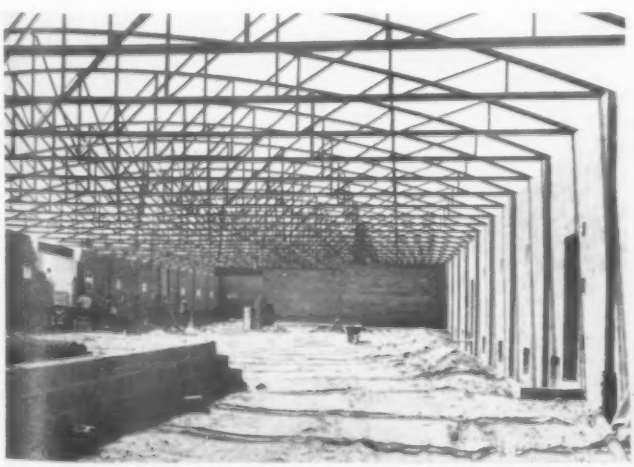
By the time this appears in print, another great national meeting will have been concluded. I feel confident at this time in going so far as to say it was a great meeting with many accomplishments achieved toward the continued success of the organization.

What comes after the Los Angeles meeting, frankly, I am not looking forward to with any great enthusiasm. Moving day—Monday, November 1, 1948. However, I am sure it will be well worth the effort and inconvenience and your entire staff joins me in assuring you that we are all looking forward to doing an even better job with our new tool—the new headquarters building.

Ladies Night Program Inaugurates New Season

Kansas City, Mo.—Kansas City Chapter opened its fall season with a Ladies Night dinner, held September 1 at the Advertising and Sales Executives Club. The affair was attended by 74 members, their wives and guests.

Following dinner and a musical entertainment, H. B. Beeson, District Representative for the Aluminum Company of America, presented two films. One, "Unfinished Rainbows," reviewed the history of the aluminum industry, which will be 60 years old next month. The other motion picture presented operations and problems encountered in drawing aluminum sheet on presses.



ASTE Helps Train T.E.'s To Industrialize Orient

On the other side of the world in a strife-torn land now bent on becoming a modern industrial nation, ASTE is extending a helping hand in advancing engineering education.

The country is India; the ASTE representative—Gopal Chandra Sen, M.S.E., a Detroit Chapter member.

Mr. Sen has just reopened his faculty desk at the College of Engineering and Technology, Bengal, in Calcutta. It seems good to him to be back at his post in India's largest school after a year's absence in the United States.

But it was a wonderful year—working for his master's degree in Mechanical Engineering at the University of Michigan, as assistant to Professor O. W. Boston, Chairman of the Department of Metal Processing; visiting American manufacturing plants; and inspecting new production machinery displayed at mammoth industrial shows.

Rate Well in American Schools

Yes, he has much to tell the 800 mechanical engineering students represented among 2000 enrolled in various branches of engineering.

They'll be proud to learn that their fellow countrymen are doing well in American universities; that they experience no difficulty in transferring from India's high-standard colleges. That, in aptitude and intelligence, they rank easily with their Occidental classmates.

Young Mr. Sen can explain how modern mass production methods have brought Americans luxuries yet unknown to many of India's teeming millions. He can give assurance that mechanization does not cause unemployment.

For he has watched workers, talked with them and with their superiors in plants at South Bend, Milwaukee, Chicago, Detroit, Cleveland, Cincinnati, Hartford and Providence.

Besides he's read the mass production gospel in *The Tool Engineer*, discovered while doing research in the engineering library at the University of Michigan. In fact he became so interested in the organization publishing this periodical that he asked Professor Boston, himself a staunch ASTE'er, about the American Society of Tool Engineers.

Now that Mr. Sen's a member, too, his own copy of *The Tool Engineer* will make the long journey over land and sea, bringing him and his eager pupils needed information to develop their country's infant industrial machine.

Already India has begun two auto assembly plants, one shipyard, plans aircraft factories, hopes to build complete motor cars by 1952. It turns out over a million and a half tons of steel, has some machine tool industry, makes textile and other machinery. Its southern forests furnish pulp, paper and other wood products.

The Indian worker, Mr. Sen finds, likes industrial employment, enjoys the manufactured goods he is able to acquire with a gradually rising standard of living, is hesitant about accepting mechanization, which runs counter to Gandhi's teachings.

But two features of the American way of life which most impress Educator Sen are still in the future for his homeland: a great network of fine highways following the automobile's rise in popularity; and the ubiquitous "drug store," that handy emporium where one may drop in day or night and pick up anything from a dog biscuit to an electric refrigerator. "India," he smiles ruefully, "has nothing like that."

Heckinger at Tools, Inc.

Upper Darby, Pa.—David J. Heckinger of Philadelphia Chapter, ASTE, has joined Tools, Inc., as head of the Philadelphia office, E. Hollingsworth, Company president, has announced.

For the past 12 years Mr. Heckinger has been with Fansteel Metallurgical Corp. as Field Service Engineer in the St. Louis and Philadelphia offices.

Active in the formation of Kansas City and Decatur Chapters, ASTE, he has served as Publicity Chairman of St. Louis Chapter and on the Membership Committee of Philadelphia Chapter.

Muir Named Editor

Detroit, Mich.—The appointment of Gilbert P. Muir as Editor of *The Tool Engineer* has been announced by Frank W. Curtis, National Editorial Chairman, ASTE.

G. P. Muir

A native of McKeesport, Penn., Mr. Muir was formerly editor of the journal, *Steel Processing*, and more recently editor of *Watkins Cyclopedia of the Steel Industry*. He attended the University of Pittsburgh.

T.E.'s Turn Athletes For Annual Stag Outing

St. Louis, Mo.—Three hundred and six St. Louis tool engineers left their drawing boards for a day of recreation at the Chapter's annual stag picnic, held this summer in Tamme's Grove, Fenton. Attendance was limited to ASTE members.

The energetic engaged in such sports as swimming, ball games and horseshoe pitching. Prizes were awarded to winners of the athletic events, and the traditional "grab bags" distributed by the gate committee contributed to the fun. Everybody had a good time and plenty of tasty food.

Committee for the well-engineered affair was headed by "Skip" Stempfel.

Bock, Council Officer

Columbus, Ohio—W. E. L. Bock, Chief Engineer of the Superior Die Tool and Machine Co., has been elected Vice-President of the Columbus Technical Council, an organization of 15 Central Ohio technical societies.

He is a former chairman of Columbus Chapter, ASTE.

Bamboo Used to Drill Oil Wells, 2000 B.C.

Detroit, Mich.—As early as 2000 B.C. oil wells were being drilled in China to a depth of 2000 feet with bamboo equipment. Although the drillers were seeking salt, they usually found petroleum along with the saline deposits.

Addressing some 250 Detroit members at the Engineering Society of Detroit, September 9, H. E. Heywood, Jr., of National Supply Co., went on to describe present equipment capable of boring 20,000 feet below the surface.

A hole 3000-4000 feet deep, which he termed a "post hole," represents an average investment of $25,000 in labor and $80,000 in machinery. As much as a million dollars, he added, may be spent on a "dry hole," such as the Fort Cobb well drilled to a depth of 17,823 feet, then abandoned as a failure.

Construction and operation of drills and the complete process necessary to the successful capping of an oil well were described by Mr. Heywood and depicted in motion pictures.

Dinner and a film review of the Chapter's summer golf tournament preceded the lecture.

Guests included L. A. Ringman, Works Manager, and H. L. Wilkie, Chief Engineer, National Supply Co., and Ian Scott, Chief Engineer of Oil Well Engineering Co., England.

Paatsch Opens New Div.

Milwaukee, Wis.—Fred C. Paatsch, owner of Fred C. Paatsch Co., has announced the formation of a new company division, Screw Machine Tool & Supply Co.

Devoted to serving the screw machine industry, the new firm will endeavor to stock or make prompt delivery on such tools and supplies as are usually not obtainable from regular mill supply distributors.

Mr. Paatsch, a Milwaukee Chapter ASTE member, points out that the parent company will continue to specialize in toolroom tools.

Joins Mouldings, Inc.

Indianapolis, Ind. — Richard Watson has accepted the position of Methods Engineer for Mouldings, Inc., in Indianapolis. He was formerly on the staff of Kahl Tool & Die Co., E. Detroit, Mich.

Mr. Watson has transferred his ASTE membership to Indianapolis Chapter from Pontiac, where he was a charter member. Earlier he was affiliated with Detroit Chapter.

Kotler With Reltok

Boston, Mass.—Frank W. Kotler, former Vice-President and General Manager of F. F. Gilmore & Co., is now affiliated with Reltok Diamond Tool Co., also of Boston.

A member of Boston Chapter, ASTE, Mr. Kotler has devoted the past 25 years to perfecting diamond cutting processes and improving diamond tool design.

Set Up Tool Design Course in Government School

Toronto, Ont.—Plans for a Tool Design course to be conducted with the cooperation of Toronto Chapter, as part of a school of Machine Tool Technology sponsored by the Province of Ontario, were developed in a recent special meeting of Chapter officers and invited guests. The meeting was held at the Ryerson Institute of Technology where the school will be located.

J. W. Lengbridge, Chapter Chairman, and Roy Sherk, of the Education Committee, discussed the course. Mr. Sherk has been chosen to head up the Machine and Shop Work Div. of the School of Technology.

As proposed the Tool Engineering course would be divided into two phases. One covers drafting, trigonometry, inspection, and laboratory instruction, while the second is a general course in Tool and Die Making, including Machine Shop Practice.

Mr. Sherk was instructed to survey industry management for guidance in setting up the training classes.

Following talks by Mr. Lengbridge and Mr. Sherk, the group was conducted on a tour of the machine shop, laboratory, and drafting departments of the Rehabilitation School. These facilities are to be converted to the establishment of the School of Machine Tool Technology.

The Chapter is also investigating the possibility of using the lecture room of the new school for monthly ASTE meetings.

Wirt Talks on Brazing

Indianapolis, Ind.—J. R. Wirt, Welding Engineer, of the Delco Remy Div., General Motors Corp., addressed the opening meeting of the season at Indianapolis Chapter, September 2. He talked on "Low Temperature Brazing."

Mr. Wirt used a display board of samples and showed slides in conjunction with his lecture.

Kinloch, Petz, Winners In Tooling Idea Contest

Detroit, Mich.—Two ASTE members have carried off prizes in the Tooling Idea Contest announced at Detroit Stamping Co.'s exhibit in the Society's 1948 Exposition at Cleveland.

Award winning contributions included a bending and forming fixture submitted by Robert S. Kinloch of Pittsburgh Chapter, and a holding operation with auxiliary arm entered by Joseph L. Petz, First Vice-Chairman, Mid-Hudson Chapter.

Other awards went to L. G. Patterson, Three Rivers, Carl A. Licht, River Rouge, Mich.; Charles R. Pettis, Jr.; and Earl W. Obringer, Cleveland, Ohio. Prizes included a console radio phonograph and five table model radios.

Purpose of the contest was to uncover ingenious and practical applications of the company's toggle clamps, for availability to those with work holding problems.

"Down East" Shore Dinner Highlights Portland, Maine, Outing

Upper, left: Steamed clams, lobster and all the fixin's of a full shore dinner make 64 contented tool engineers at Portland, Maine, annual outing this summer at Stickney Lodge near Goodwin Mills. Right: At far side of near table are, from left, Frank Hugo, Sales Mgr., George Hugo, Plant Supt., Arnold Roberts, Draftsman, and Morris Hugo, Pres., Portland Copper and Tank Works, Inc. Facing camera in foreground is Joseph Feeney, Boss Machinist on ships. Right: I. F. Holland, ASTE Pres., A. M. Sargent, Past Pres., and H. E. Conrad, Executive Secy., are among spectators cheering the horseshoe tournament. Lower, left: Thomas Laughlin Co., Portland, turns out in force for the outing. Right: John Greene, Supt., Thomas Laughlin Co., and George Hugo, Supt., Portland Copper and Tank Works, Inc., are partners in horseshoe pitching

Tool Engineers' Handbook Authors

Biographical Briefs

Jig and Fixture Design Committee

Joseph I. Karash, Plant and Process Engineer, Reliance Electric & Engineering Co., Cleveland, Ohio, is Chairman of the Jig and Fixture Design Committee for the Handbook.

In 19 years' association with Reliance, he has served in the experimental laboratory, the dispatching, production planning, methods, time study, and tool design departments; as safety engineer and plant engineer.

Mr. Karash is known throughout the Society for his many lectures on the design of dies for inclinable presses. He is the author of "Analysis of Drill Jig Design"; has written numerous technical articles for trade publications.

A former Chairman of Cleveland Chapter, ASTE, he is also a member of the Cleveland Engineering Society and the Cleveland Junior Chamber of Commerce.

* * *

Entering industry as a machinist's helper, **William A. Dorff** became skilled enough to work as a tool and die maker for several years while attending school.

After study at Pennsylvania State College and through correspondence courses in electrical and mechanical engineering, he spent a number of years in research work, tooling and machine design.

A Cleveland ASTE member, Mr. Dorff is now engaged in tooling jet engines at Thompson Aircraft Products.

* * *

Now foreman of the Tool Design Section, Punching, Tool and Die Div., General Electric Co., Schenectady, N. Y., **Edward H. Girardot** has had 24 years' experience in tool, die, and special machine design.

A General Electric graduate apprentice, he has taught tool design in a technical high school, in a New York State vocational school, and at Rensselaer Polytechnic Institute. He is the author of articles on tool and die applications.

During the General Electric-sponsored welding session presented at the 1947 ASTE convention in Boston, Mr. Girardot read a paper on "Welding as Applied to the Construction of Tools, Dies, Jigs and Fixtures."

He is a Past Chairman of the Schenectady ASTE Chapter and headed its Standards Committee for several terms.

* * *

Edward J. Marasko, Tool Engineer, Glenn Tool Co., Cleveland, Ohio, specialized in machine design in technical high school, did post graduate study in tool and machine shop practice at Cleveland Trade School, followed by engineering courses at Fenn College.

Then he served an apprenticeship at Bailey Meter Co., where he began his engineering practice. Other associations with Thompson Products Co., National Tool Co., Pump & Products Co., Weatherhead Co., and Machinery, Tool & Product Engineering Co. have given him a diversified professional background.

Keenly interested in standardization, he has given outstanding service as Chairman of Cleveland Chapter's Standards Committee, is a member of the ASTE National Standards Committee. Mr. Marasko is registered as a Professional Engineer in the State of Ohio and holds membership in the Cleveland Society of Professional Engineers.

* * *

Walter J. Rubin, Standards Engineer at Reliance Electric & Engineering Co., Cleveland, directs all industrial engineering for his firm.

He entered this field at the Bedaux Co. in 1927 after completing his formal technical education. Then he went to White Sewing Machine Corp. and later to the Mills Co., in time study engineering.

In 1931 he returned to industrial engineering at Stinson Aircraft Corp., Wayne, Mich., transferring a year later to Addressograph-Multigraph Corp., Cleveland. Since 1937 he has been with Reliance.

Besides his membership in Cleveland Chapter, ASTE, Mr. Rubin is affiliated with the Industrial Management Society, Chicago.

* * *

From **Lloyd W. Sahley's** drawing board have come special purpose high production machine tools for the automotive industry and a new, compact, general purpose hydraulic transfer molding press.

Now Mechanical Engineer for Addressograph-Multigraph Corp., Cleveland, he has been associated with Sommer & Adams Co. as Design and Development Engineer, and with Parker Appliance Co. in the capacity of Chief Tool Designer and Supervisor of Process Planning Dept.

Earlier connections include McKinney Tool & Mfg. Co., Fairchild Engineering Co., the Yoder Co., and Cleveland Tractor Co.

He was trained in general and standard cost accounting, industrial management, time and motion study, and industrial design, at Western Reserve University and Cleveland College.

He has been active in Cleveland ASTE Chapter projects.

JIG AND FIXTURE DESIGN COMMITTEE

J. I. Karash

W. J. Rubin

E. J. Marasko

E. H. Girardot

W. A. Dorff

Films Show Advances In Cutter Sharpening

Baltimore, Md.—New developments in cutter sharpening were viewed in color motion pictures and slides by about 45 Baltimore members attending a dinner meeting, September 8, at the Engineers Club.

H. M. Huffman of Cincinnati Milling & Grinding Machines, Inc., presented the technical program. A film depicting Universal tool grinder setup both for commonplace and unusual types was followed by slides showing technicalities of angles and contours necessary to sharpen cutters properly, and included high speed steel as well as carbide tipped tools.

Mr. Huffman showed another film of processes and operations at the Cincinnati plant and conducted a question and answer period.

Coffee speaker was Walter S. Driskell, Manager of the Baltimore Colts, who discussed aspects of pro football and made predictions for the season.

Chairman George Exley presided and Vice-Chairman Andrew Jones presented the technical speaker.

New members announced at the meeting are: Charles H. Suiter, John W. Schukraft, Charles A. Magee, Leon E. Laux, Robert M. Finley and George M. Boring. Refreshments were served during the evening.

Lannens Form Company

Detroit, Mich.—Joseph P. Lannen and Robert J. Lannen, of the Detroit ASTE Chapter, have organized the Micro-Poise Engineering & Sales Co., 14851 Grand River Avenue, Detroit.

The new firm will distribute Micro-Poise balancing machines and furnish engineering service for specific installations.

Both partners have been connected with Commerce Pattern Foundry & Machine Co., makers of the equipment.

Mid-Hudson Entertains 300 at Second Annual Picnic

Poughkeepsie, N. Y. — Mid-Hudson Chapter held their second annual picnic this summer at Shady Brook Park. The weatherman cooperated with the picnic committee by furnishing a perfect day for the pleasure of more than 300 members, their families and guests.

I. F. Holland, Society President, was a guest. He spoke briefly and commended the Chapter on the success of the affair.

An enjoyable afternoon of golf putting, baseball, horseshoes and refreshments was climaxed with the awarding of prizes to winners of the various events. Door prizes were also awarded. Following the games, a barbecued beef picnic supper was served.

The committee in charge of the event was comprised of Joseph Crane, Chairman; Henry Biederbecke, Joseph Spahn, Jack Petz, Donald Winslow, Charles Brownell, George Vermilyea, Samuel Enright, John Young, Llewellyn H. Tenney, Chapter Chairman; and Joseph L. Petz, First Vice-Chairman, Fred K. Neumann, J. Harry Keller, Noel DeCordova, James Hillis, Theodore Luty, Ellis Thorp, Raymond Lansing and Stanley Cook.

* * *

Various standing committees have met through the summer to plan Chapter activities for the coming year. The Program committee, under Theodore Luty, has a complete tentative schedule arranged.

This month the Education Committee, headed by Ellis Thorp, expects to inaugurate an evening course in fundamentals of Tool Design, with the cooperation of the Poughkeepsie Board of Education.

James Hillis, Standard Chairman, is working with local industries on the issuing of data sheets. The Membership Committee, chairmanned by Charles Brownell, has plant representatives stimulating greater Chapter interest and contacting prospective applicants.

Vice-Chairmen Joseph L. Petz and Second Vice-Chairman Fred Neumann are working with the committees under their jurisdiction. Chairman L. H. Tenney, member ex-officio of all committees, and Past Chairman John Petz, a member of the Executive Committee, are lending valuable advice and enthusiasm to all Chapter activities.

Top: President I. F. Holland (third from left standing) congratulates the Picnic Committee on successful outing engineered for Mid-Hudson Chapter. Below: The bread line gets a mouth-watering view of the tasty viands in store

Kronenberg Enters Field Of Consulting Engineering

Cincinnati, Ohio—Dr. Max Kronenberg, for nearly 12 years Research Engineer with Cincinnati Milling & Grinding Machines, Inc., has established a consulting service in Cincinnati.

Dr. Kronenberg will specialize in machine tools, production methods, metal cutting research, domestic and foreign patent investigations in litigation and allied fields.

A graduate of the Engineering College of the University of Berlin, he had a distinguished career abroad, both in industry and science before settling in the United States and becoming an American citizen.

He is an early member of Cincinnati Chapter, ASTE, has chairmanned its Education Committee and is credited with the derivation of basic relationships involved in metal cutting. His data are frequently quoted in the "Principles of Metal Cutting and Machineability" section of the forthcoming ASTE "Tool Engineers' Handbook."

ASTE Families, Guests At Green Bay Outing

Fond du Lac, Wis.—Approximately 100 Fond du Lac members, their families and friends gathered at the Shorewood Country Club in Green Bay, August 15, for the Chapter's annual outing.

Golf, foot races, a tug-of-war, a special wheelbarrow race, and other games both for men and women headed the program.

W. E. Rutz, Vice-President and Works Manager, Giddings & Lewis Machine Co., was master of ceremonies and presented awards to winners of all the contests. A buffet dinner was followed by dancing.

Gideon Kane chairmanned the committee in charge of the event, assisted by "Ted" De Bruc and R. A. Carstenson.

Wallace Joins Colonial

Windsor, Ont.—Stanley Wallace, for 34 years associated with the Ford Motor Co. of Canada, Ltd., has joined Colonial Tool Co., Ltd., here, in the capacity of Field Service Manager.

A well-known Canadian tool engineer, active in Windsor Chapter, ASTE, and Michigan Chapter, American Society for Quality Control, Mr. Wallace most recently was in charge of manufacturing and foundry inspection, special gears department, tool inspection, and gauge design with Ford Motor Co. of Canada.

Groman Promoted

New York City—Robert H. Groman of Tri-Cities Chapter, ASTE, has been named to the Board of Regional Sales Supervisors, Eutectic Welding Alloys Corp., R. D. Wasserman, Company President, has announced.

Formerly a welding specialist attached to the Eutectic Service Dept., Mr. Groman later became Assistant to the General Sales Manager, and now assumes the responsibility of Regional Sales Supervisor in the West Central area.

Coming MEETINGS

AKRON—November 8. Speaker from Progressive Welder Co., Detroit. Subject: "Tooling for Resistant, Projection and Spot Welding."

BOSTON—October 14, 6:30 P. M., New England Mutual Hall. Speaker: A. J. Snyder, Vice-Pres. and Works Mgr., Morse Twist Drill Co., New Bedford. Subject: "Small Hole Drilling and Tapping." Also: Dr. Albert C. Hall, Director, Dynamic Analysis and Control Laboratory, Massachusetts Institute of Technology, Cambridge. Subject: "Guided Missiles."

CHICAGO—November 1, Furniture Club of America. Speaker: H. E. Faulkner, Dept. of Public Relations, General Motors Corp. Subject: "General Motors Previews of Progress."

DENVER—November 10, 6:30, at Silver Wing. Speaker: H. B. Osborne, Technical Director, Tocco Div., The Ohio Crankshaft Co. Subject: "Induction Heating."

DETROIT—October 14, Mechanical Laboratories, Engineering College, University of Michigan, Ann Arbor, Mich. Dinner at Union Bldg., 6:30 P. M. Speaker: Prof. O. W. Boston, Chmn., Dept. of Metal Processing, U. of M. Subject: Relation of U. of M. facilities to production work and tool engineering. Trip through laboratories will follow lecture.

November 11, Rackham Educational Memorial Bldg. Dinner, 6:30 P.M.; meeting, 8:00 P.M. Speaker: Capt. Leon Jacobi, Chief of Naval Reserve, Detroit Area. Subject: "National Defense and the Naval Reserve."

FLINT—October 21, 7:00 P. M., Frankenmuth. Speaker: William J. Bank, Customer Relations Assistant, Michigan Bell Telephone Co., Detroit. Subject: "Television Highways and Their Relation to the Bell System."

FOND DU LAC—November 12, 6:30 P. M., Conway Hotel, Appleton, Wis. Speaker: Miss Beth Dailey, Executive Secretary, Oshkosh Chapter American Red Cross. Subject: Travelogue on Japan, with colored films, based on wartime experiences with the Red Cross.

NIAGARA DISTRICT—November 4 at Welland, Ont. Speaker: R. S. Woodbury, American Bosch Corp., Welland. Subject: "Internal Combustion." December 2 at St. Catharines. Speaker: Adam Gabriel, Acme Industrial Co., Chicago, Ill. Subject: "Light Waves and Their Uses in Precision Shop Measurements."

PEORIA—November 5, 6:30 P. M., Jefferson Hotel. Speakers: H. W. Highriter, Technical Director, L. Dean, Tantung Div., E. T. Pickford, Supt. of Production, Vascoloy-Ramet Corp., N. Chicago, Ill. Will show film on Refractory Metals and Tantung Precision Casting, to be followed by panel discussion.

RACINE—November 1, 6:30 P. M., Kenosha Eagles Club, Kenosha, Wis. Speaker: K. N. Macomber, Chief Service Engineer, Lapointe Machine Tool Co., Hudson, Mass. Subject: "Tooling for Jet Propulsion." December 6, 6:30 P. M., Racine Manufacturers Bldg. Speaker: E. B. Rhodes, Industrial Sales Representative, Bendix-Westinghouse Mfg. Co., Elyria, Ohio. Subject: "Air Operated Holding Devices."

SPRINGFIELD, ILL.—November 9, 6:00 P. M., The Mill, 906 No. 15th St. Speaker: R. H. Davies, Consulting Engineer, Lincoln Electric Co., Cleveland. Subject: "Arc Welding."

TOLEDO—October 13, 7:00 P. M., Toledo Yacht Club. Speaker: S. E. Beer, Special Sales Representative, Monarch Machine Tool Co., Sidney, Ohio. Subject: "New Developments in Turning Equipment."

TORONTO—November 3. Subject: "Choice of Tool Steels," sponsored by Design and Service and Atlas Steel Co., Ltd. December 1. Subject: "Carbides," sponsored by Canadian General Electric Co., Ltd., A. C. Wickman, Ltd., and Kennametal Co., Ltd.

WICHITA—October 13, 7:00 P. M. Plant tour of Cessna Aircraft Co.

Faber Now Plant Manager

Toledo, Ohio—Elmer Faber has resigned as Director of Engineering for Ransom & Randolph Co., to accept the position of Plant Manager and Director of the Swiss Automatic Co., Marysville, Mich., makers of precision screw-machine products.

In removing to the Michigan community, Mr. Faber also resigned his office as Program Chairman of Toledo Chapter.

Obituaries—

Wilbur C. Massow

Wilbur C. Massow, Assistant Sales Manager of Walsh Press and Die Co., Div. of American Gage and Machine Co., passed away July 26 in Chicago after a brief illness.

Mr. Massow was born in Chicago, Ill., October 26, 1912, and received his education at Northwestern University. He was a member of the Chicago Chapter, ASTE. He had been associated with the jewelry and silver manufacturing division of Marshall Field & Co., with Charles Bruening Co., Don Hall Tool Co., and the Cliff Co.

* * *

Lowell B. Gilbert

A few hours after recently being elected President of the Business and Civic Association of Tonawanda, N. Y., Lowell B. Gilbert, 52, Factory Manager of Columbus McKinnon Chain Co., succumbed following a heart attack.

Mr. Gilbert had been about the plant during the day, apparently in his usual health. In the afternoon he was present for the opening of the annual meeting of the board of directors of the Business and Civic Association. Complaining of feeling ill, he asked to be excused, then collapsed and was removed to DeGraff Memorial Hospital where he passed away that evening.

Born at Alfred, N. Y., he attended the public schools in Wellsville, was graduated from Pratt Institute, Brooklyn, as an Industrial Mechanical Engineer. He was associated with General Electric Co. and Consolidated Machine Tool Corp. before joining Columbus McKinnon in 1937 as Assistant to Factory Manager.

Active in business and civic affairs, he was a member of the Rotary Club and chairman of the industrial committee, Business and Civic Association. Other affiliations included Buffalo - Niagara Frontier Chapter, ASTE; Sutherland Lodge, F and AM; Tonawanda Chapter, RAM; the First Church of Christ, and the McKinnon Foremen's Club, of which he was a past president.

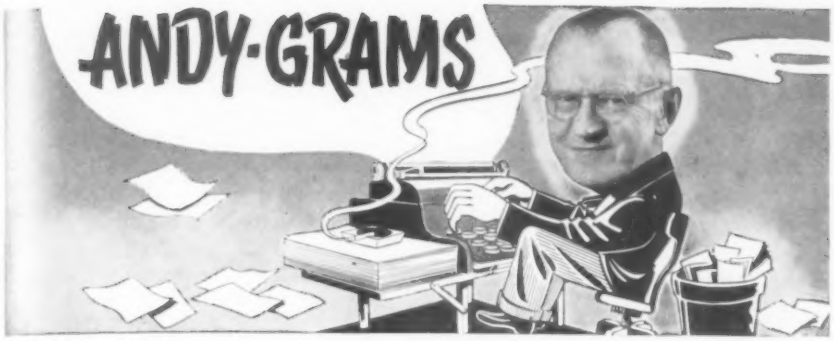
* * *

Elmer E. White

Elmer E. White, Milwaukee Sales Engineer for Small Tools and Gages, Pratt & Whitney, Div. Niles-Bement-Pond Co., W. Hartford, Conn., died suddenly at his Milwaukee home, July 21, at the age of 52.

He was born at Pasadena, Calif., and graduated from Detroit Engineering College. He had represented Pratt & Whitney in the Milwaukee area since 1927, and was widely known to industrialists for his knowledge of cutting tools and precision gaging.

Mr. White was an active member of Milwaukee Chapter, ASTE, and was a Shriner, Tripoli Temple.



Seems I'm bound to get in Dutch no matter what I do or how good the intentions, apropos which you might give the double O to the letter from Mr. Grodzinski, at the bottom of Fundamentals of Tool Engineering, this issue. Y'know, I had that drawing "technically" right at the beginning, only it didn't look right even when it was right so we (editorially speaking) purposely made it wrong to make it right. Plain as mud, eh?

Now, it's true that our Art Director, Bob Steiger, hasn't had very much practical shop experience, having been busy during the late fracas exchanging confeetti with our erstwhile enemies. But, he's a cracking good artist and a swell boy to suit, and I can't let him take the blame when I'm around to be the goat. Anyway, Mr. Grodzinski didn't pan my grandpop who is in no way to blame for the aberrations of his scion, so it's all okay. I like letters like that; they jack you up when you bog down.

Well, things are moving along and the boys are getting back in the groove now that vacation time's over—that is, for about everybody but me. And I'm taking one, come heckelfelt or high water, but where I haven't decided as yet. Frank Martindell was telling about gallivanting down around Arkansas way where he ran into Ozark smörgåsbord at the Hilltop Lodge, all recommended by Al Lindstedt. Wonder if it beats the Paddock up in Vermont?

Speaking about smörgåsbord, Clarence Etter—and there's one right guy!—and likeable Jim Hartnett, both of The Tool Engineer advertising staff, breezed in during their rounds, wherefore we took our new editor, Gil Muir, around to the Stockholm for eats. Got to get the guy started right, y'know, and there's no welcome like a good feed.

Personally, I started the ASTE fall season by attending Detroit Chapter's opener, where H. E. Heywood, Jr., gave a most interesting talk on Oil Well Drilling. Apropos this, it has come to my ears that some people have an idea that the tool engineers are cutting tool specialists, and sure enough there's plenty of our boys who qualify in that field. But, our ramifications are so broad that, figuratively speaking, we "cover the waterfront" in tooling the world.

One thing that arrested my attention was the reference to *fundamentals*, a basic essential in any field of endeavor that has been so repeatedly stressed in The Tool Engineer that it has become a byword. If you know the fundamentals of any process, you're bound to muddle through to a logical solution somehow, but if you don't know them you're just boarding a merry-go-'round—a lot of travelling without getting anywhere.

Anyway, it was nice getting together with the Detroit tool engineers although it's been so seldom that I'm beginning to be a stranger in my home town. One guy I recognized right away—myself, in a movie—although I had to look twice before it clicked, the way they had me dancing around so. As usual, the camera cheated—didn't show half the hair on my head.

A letter from Ed Helm of South Bend, enclosing a request for a "catalog" from the schoolboys over in Nigeria and wondering how he got it. Well, those letters have been a standing joke in the technical publications field for quite a while. Personally, though, I can't see anything particularly funny about them; rather, I have a deep and abiding sympathy for those natives of Africa who are groping their way from stone age culture to what we are pleased to call our modern civilization.

From one thing to another, I find myself saddened, not to say shocked and outraged, by the senseless murders of Count Folke Bernadotte and his aide, Col. Andre Serot. A fine Christian gentleman, known more or less intimately to many of us here in the ASTE, the Count had dedicated his life to the cause of humanity and, during world war II, had risked his life time and again in saving unfortunates from concentration camps and worse.

Well, words can't bring him back and murder but speeds him toward immortality. In the volumes of newspaper comment, however, one sentence arrests attention: "He had integrity." An intangible quality, that, yet withal of such solid substance that the possessor is immune to all but lethal attack. And even death cannot destroy the spirit.

In common with a lot of us, I've been having my troubles with a postwar car although, as for that, the biggest trouble has been getting another to replace the one I've got. And maybe I'd be jumping from the frying pan into the fire by changing, so maybe I'd better keep what I've got.

Not, in this connection, that I'm disparaging the quality of the modern cars which, on the whole, are superlatively engineered and incorporate every possible safety feature except—in too many instances—a safe driver. Apropos which I've long contended that a minority of repeaters is responsible for most accidents. That contention was corroborated in a recent magazine article, in which research had established that repeaters were the main cause of accidents in all walks of life, including industry and the home.

Speaking for myself—and I'm knocking wood—I've been driving well over 40 years without any worse damage than a dented fender and a bent rear bumper where someone tried to climb over me. And I can name scores of old timers with equal or better records.

In my opinion, one reason for the great number of traffic accidents is that our system of traffic control is punitive rather than educational and preventative. Punishing a driver after an accident doesn't cancel the fact of the accident, but subjecting all drivers to a rigid test, to establish fitness, would go a long way toward weeding out the misfits.

Again, we come down to fundamentals. What proportion of modern drivers, for example, are told what to do, in emergency, when applying for a license? The emergency brake, which old timers relied on to stop a car when a brake rod let go—and in this connection, I've had hydraulic hose break in a tight spot—is now called a parking brake and seldom used even for that purpose. Yet, let a veteran of many years driving get into a strange car, and about the first thing he'll reach for is the "emergency" brake handle. It may come in handy in a pinch.

Well, that's all for now, and as usual I've been consistently inconsistent in holding to a subject. But then, variety being the spice o' life, I've given you that.

ASTEely Yours,

Andy

GOOD READING

A Guide to Significant Books and Pamphlets of Interest to Tool Engineers

KINEMATIC PROBLEMS, by **Roy Matthew Wingren**, Professor of Mechanical Eng'g at the Agricultural and Mechanical College of Texas, is a problem book to be used in conjunction with any course in the study of kinematics.

Included in the book are 40 outline sheets, laid out in such a manner as to save valuable classroom time by providing the student with pre-drawn title block, border lines, and a basic layout to illustrate the problem. Several problems are given for most of the layout sheets. Solutions are not offered, in order that the instructor select the method to fit the particular textbook being used.

Among the problems included are those related to velocities and accelerations, the location of centros for various types of mechanisms, and the functions of a number of different cams and gears. The outlines will probably suggest additional problems to the average instructor.

This kinematics practice problem book is published by *Prentice-Hall, Inc.*, 70 Fifth Ave., New York 11, at $3.00 each.

MATERIALS HANDLING MANUAL, prepared by **General Electric Company**, is designed to help in eliminating costly manual methods of lifting and moving materials and in supplanting them with modern, efficient techniques of mechanical handling of materials. Because of the tremendous scope of the subject, the manual has been limited to the receiving, warehousing, and shipping of material in the fabricating industries. The fundamentals presented, of course, are generally applicable to production-floor and other requirements.

This manual, which is but a part of an over-all General Electric program to promote scientific materials handling throughout Industry, includes a review of the basic types of equipment and their application, a 1-2-3 offering of typical savings obtained through efficient methods, and full details on a survey of materials handling methods for the average plant.

Each fully elaborated on, the five factors in making a survey are, according to the manual: knowledge of the capabilities and requirements of cranes, conveyors, and industrial trucks; careful route analysis; considerations of physical plant conditions; analysis of handling methods; and cost analysis.

A very complete section of engineering data covers the selection and use of conveyors, cranes and hoists, trucks and tractors, and battery charging equipment. Many formulae, tables, and graphs are included for computing horsepower, speeds, and other factors in the selection of equipment.

Also included are listings of manufacturers of materials handling equipment, and offices of the G-E apparatus sales organization where help on application of electrical equipment may be obtained, and a partial Bibliography.

The 92-page "Materials Handling Manual" may be obtained at $1.00 per copy from any G-E sales office or direct from the Apparatus Department, *General Electric Co.*, Schenectady 5, N. Y.

NATIONAL ELECTRICAL SAFETY CODE are now available in one 408-page cloth-bound volume. Each section has been approved by the American Standards Association as an American Standard.

Installation and maintenance rules for electric supply stations are given in Part 1, for electric and communication lines in Part 2, and for electric utilization equipment in Part 3. Part 4 contains safety rules for the operation of electric equipment and lines, and Part 5 covers radio installations.

NBS Handbook H30, "National Electrical Safety Code", may be obtained from the Sup't of Documents, *U. S. Government Printing Office*, Washington 25, D.C., at $1.25 per copy.

STRENGTH OF MATERIALS, by **Joseph Marin**, Professor of Engineering Mechanics, The Pennsylvania State College, is designed as a textbook for a first course in Strength of Materials and may be used for study and reference by those machine designers and other engineers whose activities require knowledge of this subject.

A main feature of the book is its treatment of mechanical properties of materials under various types of static stresses, coordinated with the analysis of stresses and design of simple machine and structural members. Stress analysis, mechanical properties, and design are correlated throughout.

The arrangement of the material in four classifications is designed for progressive study of the subject by undergraduate students. Part 1—Simple Stresses—includes the study of members subjected to simple tension and compression, torsion, bending, and bending and axial leads.

Part 2—Combined Stresses—deals with determination of stresses and theories of failure and design. Part 3—Statically Indeterminate Stresses—covers deflection and energy methods of analysis. Part 4—Special Topics—includes a discussion of riveted and welded joints, special problems on bending of beams, and members subjected to fatigue and impact leads.

The Appendix offers much valuable data on centroids and moments of inertia of plane areas, and a number of tables of physical properties and design stresses for common engineering materials.

This 464-page text is available at $4.75 per copy from *The Macmillan Co.*, 60 Fifth Ave., New York.

THE GENIUS OF INDUSTRIAL RESEARCH, by **D. H. Killeffer**, is intended to guide the young industrial researcher to a better understanding and surer mastery of his craft. For the sake of convenience, the field of industrial chemistry is heavily drawn upon for the material presented; however, the basic methods and techniques are found in every field of research.

It is the purpose of the author to recognize research as a habit of thought rather than mere genius which cannot be channeled for the benefit of students and engineers. He has sought out specific examples of great achievements in industry and traced their develoment and the methods of research which made them possible. In many instances, he has borrowed freely from the published papers of our leading industrial researchers, and, at times, from others less eminent.

Both theoretical and experimental research are thoroughly discussed, and the author tries not to escape any application of research by pinning down Process Research, Product Research, and Equipment Research as subjects of individual chapters. Other chapters cover the importance of pilot plants, research reports, evaluation of research results, and patents.

Mr. Killeffer has made a major contribution to industry and engineering by proving—at least, to us—that research can be made a subject for study and not accepted as a matter of individual native ability. Undoubtedly, his book will provide many young engineers with sufficient knowledge of research methods to jump right in without discouraging, faltering, half-hearted attempts at research. Possibly, it will inspire some educational institutions to establish courses of study attuned to the needs of industrial research.

The 263-page survey of research is available, at $4.50 per copy, from *Reinhold Publishing Corp.*, 330 W. 42nd St., New York 18.

THE TOOL ENGINEER'S *Service Bureau*

FREE BOOKLETS AND CATALOGS CURRENTLY OFFERED BY MANUFACTURERS

Motor, Self-Starting

Bulletin 10A offers detailed information on the redesigned (now completely self-contained) Type SX self-starting synchronous motor. Precision-built motor, complete with oil-sealed gear train, will operate in any position, has quick start and stop, and is used for many applications that require constant speed at a given frequency, such as timing devices, traffic and heating controls and communications equipment. *The R. W. Cramer Co., Inc.*, Centerbrook, Conn.

Motors, Electric

Bulletin MB-1 describes the Lima line of electric motors, multi-speed gearshift drives, and pedestal-type grinders and buffing lathes. *The Lima Electric Motor Co.*, Dept. D, Lima, O.

Heat Treating, Salt Bath

Attractive house organ will describe applications of salt bath furnaces in heat treating. First issue presents data on treatment of rock bits and paving tools; carburizing and martempering of gears and crankshafts; and new furnace design utilizing submerged electrode heating. *Ajax Electric Co., Inc.*, Frankford at Delaware, Philadelphia 23, Pa.

Machine Tools

Catalog of 32 pages covers entire line of W & S machine tools, including ram, saddle and electro-cycle turret lathes; single and multi-spindle automatics; precision threading and tapping machines; and geared scroll chucks. Tabulated specifications and illustrations of machine details are included. *The Warner & Swasey Co.*, Cleveland, 3 O.

Cut-Off Machine, Bar Stock

Bulletin DH-30 announces Model 223 wet abrasive machine for cutting 2" dia. solid bar stock and 3-½" tubing in practically any material. A description of machine details and table of specifications are included. *Andrew C. Campbell Div'n.*, American Chain & Cable Co., Inc., Bridgeport 2, Conn.

Welder, Arc

Bulletin illustrates applications where unusual advantages of the multi-range control arc welder have contributed to a better product turned out at lower cost. *Hobart Brothers Co.*, Troy, O.

Dies, Wire Forming

"Facts", a folder, highlights the advantages of tungsten carbide as applied to the manufacture of wire and wire products. Industrial Service Dept., *Adamas Carbide Corp'n.*, 40-30 23rd St., Long Island City 1, N. Y.

Testing of Materials

Bulletin 3001 highlights the portable, lightweight, supersonic Reflectoscope for accurate, instantaneous, and non-destructive testing of metals and other materials. Internal defects located at depths of up to 25 ft. *Sperry Products, Inc.*, 1505 Willow Ave., Hoboken, N. J.

Tool Lifter, Planer-Shaper

Dioner electro-automatic tool-lifter automatically lifts cutting tool from the workpiece during return stroke of planer or shaper. Described in 4-page bulletin. *Deca Company*, 4 No. Avalon Rd., Great Neck, N. Y.

Punching Machine, Gang

Folder describes a variation—from the regular line of Verson press brakes—which is designed particularly for the multiple punching of steel sheets and plates. Standard machines range from 100 to 300 tons, with bed and ram lengths of 72", 96", and 120", and will accommodate several manufacturers' punch-and-die sets for multi-punching. *Verson Allsteel Press Co.*, 9300 South Kenwood Ave., Chicago 10.

Pumps, Centrifugal

Comprehensive 28-page catalog, No. 83-29, includes line of single stage, single and double suction pumps, presenting outstanding design and construction features, listing pump ratings, and providing information on mountings, installation dimensions, mechanical shaft seals, self-priming systems, and other standard or optional features. *De Laval Steam Turbine Co.*, Trenton 2, N. J.

Metallurgy, Training for

A 96-page booklet, "Your Career with the Metallurgical Profession" is designed to help secondary school students to decide if they are both fitted for and interested in metallurgy. *American Society for Metals*, Cleveland 3, O.

Grinding Wheels

Folder offers specifications on Sterling line of cut-off, high speed snagging, and portable grinding wheels for use on a wide range of stock materials. *The Sterling Grinding Wheel Div.*, Tiffin, O.

Instruments, Laboratory

Catalog 48—274 pages—describes a comprehensive line of scientific instruments and apparatus for use in chemical, physical, metallurgical, engineering, materials testing, and other laboratories. The Aminco catalog is a valuable guide for selection of instruments for research, testing, and quality control. Available to laboratory workers, from *American Instrument Co., Inc.*, Silver Springs, Md.

Trucks, Electric

"Material Handling News" features detailed description of the electric battery-powered fork lift trucks and their applications in the heavy machinery, and other industries. *Industrial Truck Div., Clark Equipment Co.*, Battle Creek, Mich.

Welders, Spot and Projection

Type ENB press welders, for rugged but precise spot and projection welding, are described in 8-page Bulletin 3-123. Welders feature anti-friction roller welding head and heavy, rigid welded steel construction. Projection welder may be equipped with removable spot welding horns and side-mounted controls. *The Taylor-Winfield Corp.*, Warren, O.

Furnace Conversion Units

Bulletin SC 139 describes the ready change-over of "Surface" heat treating and blueing furnaces from normal gas operating to fuel oil, using standard oil standby equipment. Units burn lighter grades of fuel oil and are applicable to virtually all burners made by "Surface". Each oil nozzle is sized to provide input equivalent to the gas burner to which it is applied. *Surface Combustion Corp.*, Toledo 1, O.

Lathe, Engraving

Bulletin illustrates and describes the versatile Shapemaster Engraver, a lathe which reduces hand engraving to the speed and repetitive accuracy of machine tool work. Any design detail that can be touched by the sharp point follower may be reproduced. Generates its own master record; only one design needed for many sizes of the finished piece. Can be used for cutting intricate molds for glasswork, plastics, rubber, metal powder, and other products, as well as in making special-form punches and dies. *The Monarch Machine Tool Co.*, Sidney, O.

Lubrication Systems

Twelve-page bulletin on Alemite's four basic systems of centralized lubrication shows phantom views of each system in a typical machine installation with one lubrication point. *Stewart-Warner Corp.*, 1826 Diversey Pkwy., Chicago 14.

Microscope, Tool Room

Folder announces improved Wilder Toolmaker Microscope and its use in checking threads, angles, tapers, bevels, and other measurements. Of sturdy design for shop use, it is modestly-priced for small plants and for wider usage in larger plants. *George Scherr Co., Inc.*, 200 Lafayette St., New York 12.

Motor, Vari-Drive

Sixteen-page booklist pictures the many advantageous features of the improved U. S. Varidrive Motor, with micro-speed hand control for any speed from 1 to 10,000 rpm. A given speed is maintained regardless of load. Autotaut automatic tensioner compensates for any belt variances—prevents power loss and increases belt life. *U. S. Electrical Motors, Inc.*, Los Angeles 54, Cal.

Motors, Serve

Twelve-page bulletin provides performance, specifications, and other data on line of induction motors and generators designed specifically for high performance serve and instrumentation applications. *Arma Corp'n.*, 254-36th St., Brooklyn 32, N. Y.

Plastics Molding Machines

Bulletin provides detailed description of the H-P-M plastics injection molding machines, and how they operate. The functions of the various units—mold clamp, feed, injection unit, heating chamber, movable die-head, and operation system—are discussed in detail. *Hydraulic Press Mfg. Co.*, Mount Gilead, O.

Press Feed Unit

Bulletin describes Select-O-Matic universal power press feed unit, an adjustable ratchet-type positive feed, which provides intermittent and unvarying movement of stock through metal stamping machines and punch presses. *Earl Elwyn Smith*, P. O. Box 53, West Hartford 7, Conn.

Blow Guns

Catalog No. 20 covers line of light to heavy duty Air Saver blow guns, with unique exact-control valve, featuring a late model with rubber finger ridges for non-slip use; all-purpose and spray guns; and the line of Water Savers, also used with various other light liquids. *Lonn Mfg. Co., Inc.*, Indianapolis, Ind.

North East West South
IN INDUSTRY

General Electric Co. has announced completion of a $25,000,000 center at Lynn, Mass., for the development, testing, and production of aircraft jet engines.

The Research Committee of the **American Electroplaters' Society** has established a project, under **Dr. B. F. Dodge**, Yale University, to study the purification of waste waters containing cyanide.

Ralph H. Maxson, Pres. of the St. Paul Foundry and Mfg. Co., has been elected Chr. of the Board of **The W. L. Maxson Corp'n**, New York engineers and manufacturers. He had been a member of the Board since the firm's incorporation in 1935.

W. W. Sieg, formerly executive vice-pres., has been elected pres. of the **Titan Metal Mfg. Co.**, Bellefonte, Pa., succeeding **W. P. Sieg**, who was elevated to vice-chr. of the board.

Appointments at **Allen-Bradley Co.**, Milwaukee, Wisc., include **L. C. Watson**, formerly with Trumbull Mfg. Co., as Sales Mgr. of Distributor Sales and **Robert L. Hanson** as District Mgr. at Pittsburgh, Pa.

After 35 years of active service with the company, **H. L. Watson** has retired as Pres. of **De Laval Steam Turbine Co.**, Trenton, N. J., but will continue as a Director and Chr. of the Executive Committee. He is succeeded in the Presidency by his assistant for the past year, **George W. Smith, Jr.**, formerly senior member of the engineering consulting firm of Smith and Wood, Inc.

J. J. Topolinski, since 1943 works mgr. of **Skilsaw, Inc.**, Chicago, has been elected vice-pres. in charge of manufacturing. **Walter W. Kemphert**, formerly with Worthington Pump & Mach. Corp., was elected vice-pres. in charge of sales.

Otto G. Schwenk, previously ass't to the president of The Weatherhead Co. of Cleveland, O., has been appointed vice-pres. in charge of production of **The Yale & Towne Mfg. Co.**, New York.

Otto G. Schwenk

Walter G. Wheeler

A. G. Bryant, President of the Nat'l Machine Tool Builders Ass'n., will join with presidents of other national associations in the alloy steel consuming and producing fields and with leading steel industrialists in serving on the honorary committee for the "Salute to Alloy Steel" central theme of the Nat'l Metal Congress and Exposition at Philadelphia, Oct. 25-29. According to **W. H. Eisenman**, Nat'l Sec'y, **American Society for Metals**, "Salute to Alloy Steel" will celebrate the diamond jubilee in the history and development of these important steels.

American Foundrymen's Ass'n, 52-year old technical organization of the castings industry, has voted to change its name to **American Foundrymen's Society**, a title more indicative of the organization's actual purposes and program.

Appointments at **Kent Cliff Laboratories**, Peekskill, N. Y., makers of Micro hardness testing and allied equipment, include **Edward H. Enberg, Jr.**, to have charge of all standardization, and **John V. Verrier, Jr.**, to have charge of sales. Both men were formerly with Wilson Mechanical Instrument Co., Inc.

The **Morton-Gregory Corp'n**, Toledo, O., organized several months ago to develop, manufacture, and sell electrical specialties—has elected, as Vice-Presidents, **William J. Kane**, sales mgr. of consumer products; and **Leonard C. Barr** and **Maurice A. Enright**, general sales mgr. and general works mgr., respectively, of the **Nelson Stud Welding Div'n, Lorain, O.**

William J. Thomas has been promoted to the position of Gen'l Sales Mgr. of **The Babcock & Wilcox Tube Co.**, Beaver Falls, Pa.

COMING EVENTS

Oct. 13-15. TENTH ANNUAL FORUM, sponsored by the Porcelain Enamel Institute, University of Illinois, Urbana, Ill.

Oct. 18-22. 36th NATIONAL SAFETY CONGRESS AND EXPOSITION, sponsored by Nat'l Safety Council. Chicago, Ill.

Oct. 25-29. NAT'L METAL CONGRESS AND EXPOSITION, 30th Annual Convention, American Society for Metals. Convention Hall, Philadelphia.

Oct. 26-28. Short course on "INSTRUMENTATION FOR THE PROCESS INDUSTRIES", sponsored by Texas A. & M. College, College Sta., Texas.

Nov. 4-5. 12th ANNUAL TIME AND MOTION STUDY CLINIC. Sponsored by Industrial Management Society. Sheraton Hotel, Chicago, Ill.

Nov. 4-5. 3rd MIDWEST QUALITY CONTROL CONFERENCE, Sponsored by American Society for Quality Control and Chicago Ass'n of Commerce. Sherman Hotel, Chicago, Ill.

The Cyril Bath Co., Cleveland, has acquired **Goodyear** patents on the "roto forming" process of stretching metals to their elastic limits and, while under tension, forming upon a rotary mandrel. This process was developed jointly by the Cyril Bath Company which called it "Contour Forming" and Goodyear Aircraft which referred to it as "Roto Stretching".

The **1948 Daniel Guggenheim** Medal, for notable achievement in the advancement of aeronautics, has been awarded to **Leroy R. Grumman**, noted for his development of the Avenger, Hellcat, and other famous wartime aircraft.

Charles Bunnell, formerly with Davis Tool & Eng'g. has been appointed Plant Mgr. of the **Tait Tool Co.**, Detroit, specialists in job Kellering and tool and die contract work.

Benjamin F .McClancy, formerly of the ATF Incorporated executive staff, has been named Gen'l Mgr. of **The Associated Industries**, Cleveland, O.

Walter George Wheeler, who collaborated on the design of Hufford's 100-ton stretch forming machine, has been appointed chief eng'r at **Hufford Machine Works, Inc.**, Redondo Beach, Cal.

Earl Elwyn Smith, 53 Woodrow St., West Hartford, Conn., consulting engineer and manufacturers' representative, has been named National Distributor for Select-O-Matic power press feeds, produced by **Carl G. Peterson Co.** of Providence

The **Glidden Co.**, Cleveland, O., will build a $3,000,000 soy bean extraction plant in Indianapolis. Soya derivatives are important raw materials for paints, varnishes, enamels, and other industrial products.

Mr. Morris

Mr. Tarpy

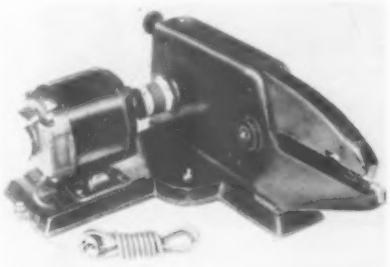
The **Ray H. Morris & Co., Inc.**, 7 So. Main St., West Hartford 7, Conn.—Recently organized as a sales and service organization, specializing in service for all makes of automatic screw machines —is headed by **Ray H. Morris**, long identified with the machine tool and small tool industry, and **Roger M. Tarpy**, formerly chief tool engineer for one of the largest clock and watch manufacturers.

Clifford G. Patch of Palo Alto, Cal., has been named manager of the Sunnyvale, Cal., works of **Westinghouse Electric Corp'n.**

TOOLS OF TODAY

High-Speed Shear

A high-speed, low cost shear called the "Grampus," designed with a small head and base to permit wide variation in work shape, is announced by its national distributors, Federal Machinery Co., 134 Grand St., New York. Material of a wide variety of shapes can be placed over the head or under the base for quick and burr-free cutting.

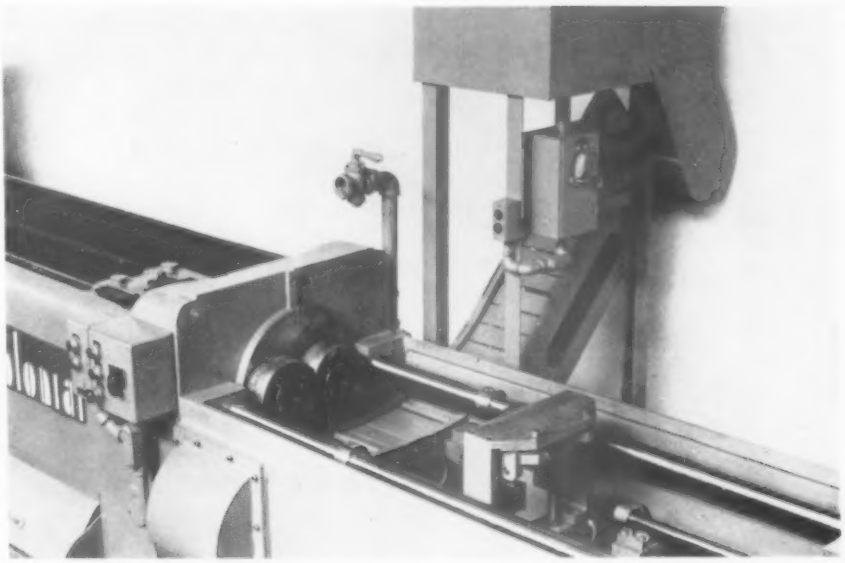


The "Grampus" is recommended for fast inside cutting, both straight and contour, by means of a simple locking device. No starting hole is required for inside work. Rated up to and including 14 gauge mild steel, there is finger-tip control of the stroke, and rapid adjustment of the cutting blades for very light material. It will handle pipe work, pans, channels, tubes, shells, etc., of various diameters and depths, within the limits of its 7" throat. **T-10-1**

Air Screw Drivers

A line of low-speed, high-torque air screw drivers and nut setters is announced by The Aro Equipment Corporation, Bryan, Ohio. There are 12 models (Nos. 7060 to 7071 incl.) in a range from 450 to 1100 r.p.m. This includes pistol type and lever type air tools with a choice of positive clutch or friction clutch.

The introduction of slow speed screw drivers and nut setters afford a number of advantages: (1) These tools provide a higher driving torque—so that larger size screws and nuts can be driven. (2) Slow speed saves bits. At slower speed, bit finds the screw slot easier and does not "chew" head of screw. (3) Attachments, particularly clutch jams, will last longer due to slower ratcheting of the jaws. (4) Slow speeds of 450 to 750 r.p.m. are particularly suited to self tapping screws and cross recessed head screws. **T-10-2**



Broaching Machine Features Automatic Handling

By combining automatic broach handling with an automatic ejector conveyor for the finished parts, physical effort on the part of the operator has been reduced while productivity per machine hour has been increased. Developed by Colonial Broach Company, Detroit, the machine, a universal horizontal broaching machine, has both the automatic broach handling mechanism and the parts ejector conveyor interlocked with the machine cycle.

The operation for which this particular machine was equipped is the simultaneous broaching of two universal joint yokes. The broach handling mechanism eliminates handling of the broach by the operator. The operator merely places the parts to be broached over the pilot ends of the broaches. The broaches then carry the parts with them into broaching position against the face plates shown in the photograph. The broaches are automatically engaged by broach pullers and are pulled through the parts.

The broaches themselves are not shown in this view, having been removed to better illustrate the automatic broach handling mechanism. **T-10-3**

Turn to Page 58 for Handy Tools of Today Coupon

Automatic Time Control Unit

Developed by the engineers of Bell Telephone Laboratories and Industrial Timer Corporation, the Model J-410 (better known as "The Goose") is especially designed for controlling the Fastax Camera. It is versatile, synchronizes the camera to the sequence of events to be photographed, allows remote control operation of the event, as well as the camera, doubles the picture-taking speed of the camera, controls film speed, thereby preventing the camera from stripping the film as it starts.

"The Goose" is compact, completely portable, simple to operate and minutely accurate. A built-in variable transformer controls voltage to the Fastax Camera from 0 to 270 volts, making the speed range of the camera infinite. Each timer has a time cycle of from 5 cycles to 5 seconds and will control the sequence of events to camera operation in any of eight different positions.

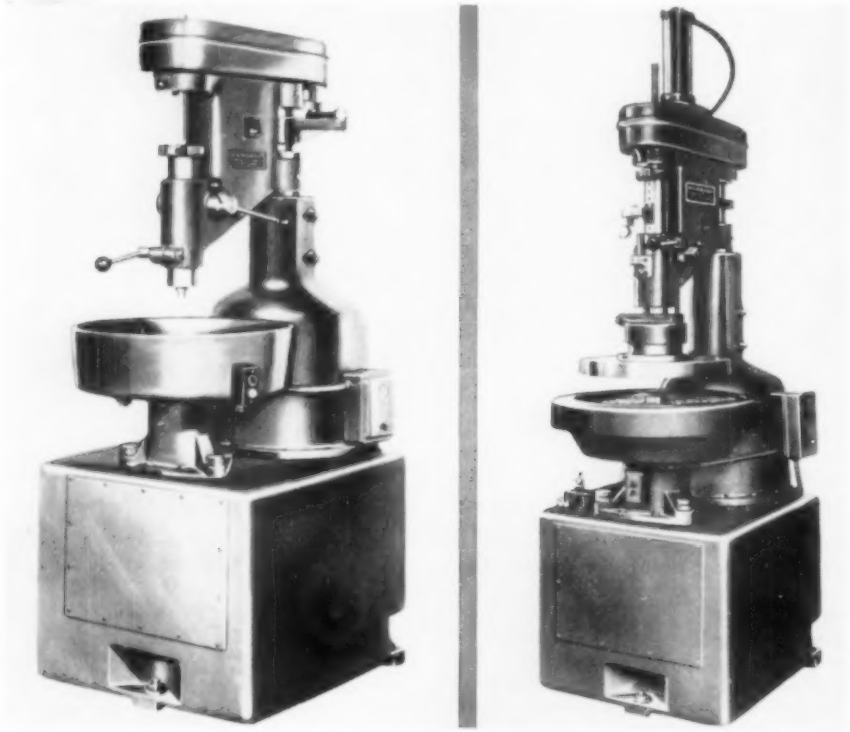
Further information may be obtained from Industrial Timer Corp., 115 Edison Place, Newark 5, N. J. **T-10-4**

Flat Surface Laps

Micromatic Hone Corporation, 8100 Schoolcraft, Detroit 4, Mich., has purchased engineering drawings and patterns from the Ultra Lap Company and announces the manuafcture of a line of machines, under the trade name Microflat, for finishing flat surfaces.

A series of six models will include two types of machines, both of which use either bonded or loose abrasives. The one shown at left will finish flat surfaces regardless of size or shape of the part, while the other—shown at right—will finish two opposite sides of parts simultaneously within 0.0001 in. for parallelism.

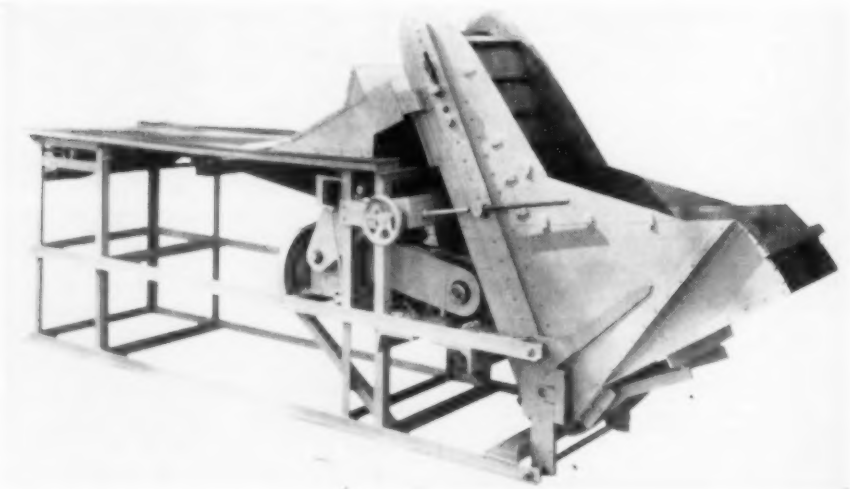
One or many parts may be processed simultaneously, and surfaces produced are claimed to be optically flat within one light-band and to be held to a finish of one microinch R.M.S. or less if desired. **T-10-5 (a) (b)**



Hopper-Fed Inspection Table

The D. H. Prutton Machinery & Tool Co., 5295 W. 130th St., Cleveland, Ohio, announces an inspection table designed for small parts such as nuts, bolts and other parts that require visual inspection rather than checking with gages. It is said that such inspection can be done at the rate of 100,000 or more per hour.

An elevator-hopper feeds the parts onto a 2 x 8 ft. conveyor belt, while a multi-speed transmission and variable angle control allows any desired distribution to the table. The table requires only 48 ft. of floor space and is built so that all moving parts are readily accessible. **T-10-6**



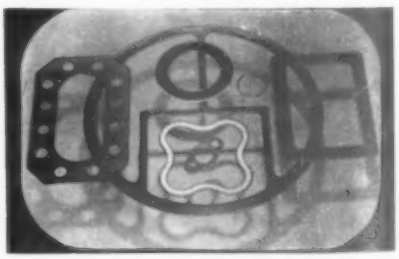
Welding Press by Clearing

A spot welding press by Clearing Machine Corp'n, Chicago, Illinois, has been developed especially for handling large and unwieldy assemblies in one step. A toggle link mechanism moves the platen up, on a 4-point suspension, to the welding electrodes.

As the platen reaches the top of the stroke, a contact on a press control panel energizes the automatic welding panel. This welding panel then takes over and causes actual welding to be performed, and with the necessary timing, while the press dwells in a closed position. At the end of the welding operation, a contact on the welding panel transfers control back to press control which returns the platen to its original position.

Metallic Gaskets

The U. S. Gasket & Shim Company, 203 Hibbard Building, Cuyahoga Falls, Ohio, announces a standard line of metallic gaskets for use in every field of industry using liquid and gas service equipment. Fabricated of light gauge brass, copper, lead, nickel, monel, and other ferrous and nonferrous materials, they are filled with a soft asbestos to provide maximum sealing and protection against extreme pressure, heat, and corrosion.



They are designed to withstand temperatures up to 850° F. and pressures up to 1500 psi. Seal is effected by the yielding—or flow—of the gasket material into the imperfections of the separable mechanical assemblies. **T-10-7**

Diamond Penetrators

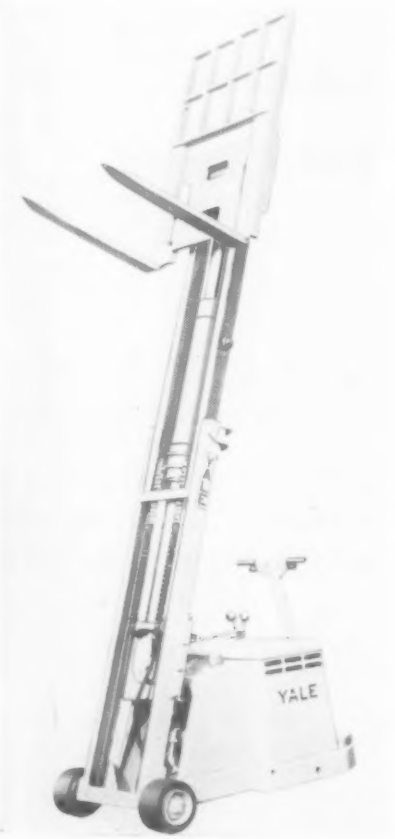
Diamond penetrators are furnished as a standard accessory on all Clark Hardness Testers, both for standard and for superficial "Rockwell" testing. **T-10-8**

Two improved Diamond Penetrators for "Rockwell" testing—the Clark "C", which fits all makes of hardness testers for standard "Rockwell" testing, and the Clark "S", which fits all machines for superficial "Rockwell" testing—are announced by Clark Instrument, Inc., 10200 Ford Road, Dearborn, Mich. Both are designed to provide accurate results, the diamond points being specially selected for proper stratification and freedom from internal stresses.

120-In. Telescopic Worksaver

A 120-inch telescopic Worksaver, announced by the Materials Handling Division of The Yale & Towne Mfg. Co., 4530 Tacony St., Philadelphia 24, Pa., is a tilting fork model said to be the highest-lifting "walkie" available. It has a capacity of 3000 lb. and was specially designed to make possible maximum use of available headroom in high-stacking operations. The high reach feature can also be used to reach such high levels as mezzanines; to service overhead cables and ducting, and to load airplanes, street trucks, and rail cars from the ground level.

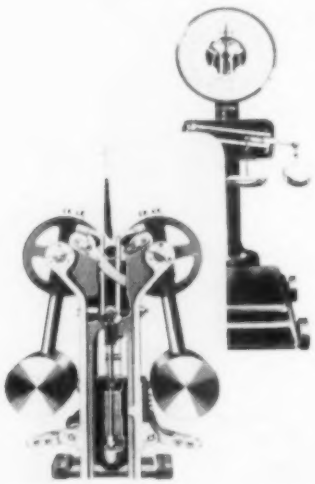
The unusually high reach—120 in.—combined with a low lowered clearance of 83 in., is accomplished by means of a ram-within-a-ram. When an outer hydraulic piston has fully extended upward, an inner one begins to extend downward, doubling the lift available. The truck travels at 2 miles per hour under full load, lifts 8 ft. per minute with 2500 lb. load, and is said to tilt a full 18 degrees in 10 seconds. **T-10-9**



Please turn to Page 58 for Handy "Tools of Today" Coupon

Dial Scale Mechanism

The Magnetrol, a dial scale mechanism just introduced by The Yale & Towne Mfg. Company, Philadelphia Division, achieves for: (1) a straight line relationship between the platform load and pointer movement without specially filed cams, adaptations to prevent backlash or delicate adjustments of the angular relationships between sectors, (2) a reduction of service adjustments from the usual six or seven to only two and (3) full but light engagement between the pointer rack and pinion by means of a permanent magnet. Also noteworthy is the fact that all moving parts are mounted at three fixed centers in a single gray iron casting (the most dimensionally stable of many materials considered). Further, they move on precision ball bearing surfaces to minimize internal friction.

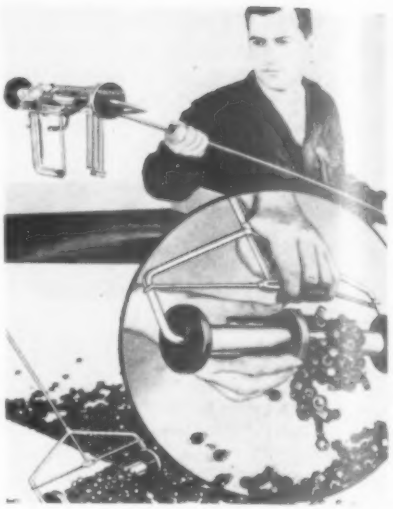


The capacity of the mechanism under direct loading without any lever system is 25 lbs; its application to large industrial loads, up to 50 tons is a matter of lever linkage. Its guaranteed accuracy is one part in 1000, but accuracies of one part in 2000 are readily obtained. The dial head, which contains a 20-inch diameter reading-line dial chart, can be swiveled through 360°. **T-10-12**

Rotary Magnets for Floor, Tank and General Uses

Improved loading and releasing principles feature a redeveloped line of non-electric Multilift rotary magnets now in production. The design provides increased carrying capacity plus efficient releasing in retrieving from tanks, separating ferrous from non-ferrous materials, picking up steel from floors, or nails from parking lots, cleaning tramp iron from conveyors and many other purposes.

The manufacturer states these units will retain their strength indefinitely without charging, requiring no wires or electricity. The Alnico permanent magnets are sealed in a metal tube mounted rigidly between Neoprene wheels in the carrying frame. Handle is attached to frame and unit is rolled; the tube revolves with the wheels and the entire magnetic surface becomes loaded, thus providing capacity greater than when only underside of magnet can be loaded. Capacity depends on size, weight and iron content of load components.



Information on non-electric Multilift rotary magnets and hand magnets is available by writing Multifinish Mfg. Co., Dept. 528, 2114 Monroe Avenue, Detroit 7, Michigan. **T-769**

Use This Coupon for Complete Information On Tools of Today Items Featured This Month

For your convenience, a key number follows the announcement of each product reviewed in the *Tools of Today* section of THE TOOL ENGINEER. To obtain complete information on any of these products, circle the corresponding key numbers on this coupon, and mail the coupon to THE TOOL ENGINEER.

Tools of Today Department, THE TOOL ENGINEER
550 West Lafayette Blvd., Detroit 26, Michigan

Gentlemen:

Please send me further information on the following Tools of Today items which I have checked:

T-10-1 T-10-2 T-10-3 T-10-4 T-10-5 T-10-6 T-10-7 T-10-8 T-10-9 T-10-10
T-10-11 T-10-12 T-10-13 T-10-14 T-10-15 T-10-16 T-10-17 T-10-18 T-10-19 T-10-20
T-10-21 T-10-22 T-10-23 T-10-24 T-10-25 T-10-26 T-10-27 T-10-28 T-10-29 T-10-30
T-10-31 T-10-32 T-10-33 T-10-34

Name .....

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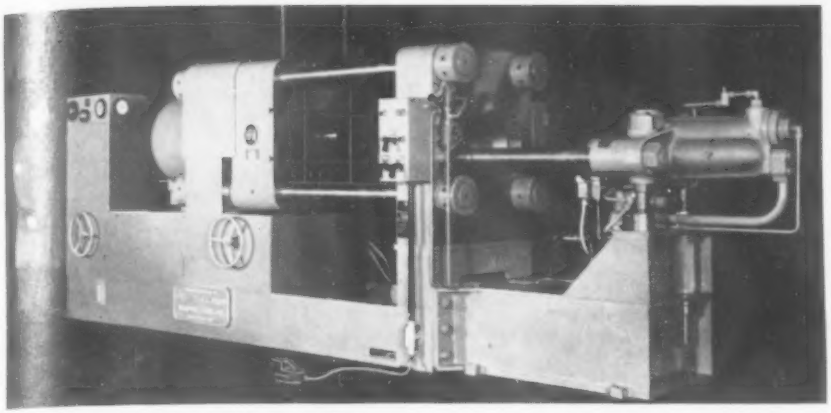
Street..... City, State.....



Cold Chamber Metal Die Casting Machine

The Hydraulic Press Manufacturing Company, Mount Gilead, Ohio, announces an improved "cold chamber" machine which is a large, self-contained, all hydraulic unit for the production of die castings of aluminum, magnesium and copper base alloys. Aluminum castings weighing up to 10 pounds each can be mass produced with this machine. A typical production example is an intricate 5 pound aluminum casting of large area produced on an average 40 second cycle. This is accomplished through the application of sustained injection pressures through the cold chamber injection system and by confining these pressures, which are high within the die cavities.

Among some of the improved features incorporated are:

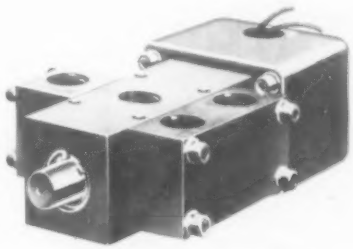
1. Clearance is provided below die space mounting to accommodate core pulls attached to the bottom of the die.
2. The adjustable vertical position of the injection assembly permits injection at either the centerline of the machine or six inches below center depending on the part and its gating.
3. Injection speed is doubled from 100 feet per minute to 200 feet per minute—without the use of additional motors.
4. All electrical controls and timers, with the exception of the operating switch panel, have been moved to the end of the machine, protecting the controls from the heat and molten metal. **T-10-14**

Carbide Thread Chasers

Carbie-tipped Thread Chasers, developed by the Jones & Lamson Machine Company, Springfield, Vt., are designed for high speed threading and, it is claimed, will cut ¾-10 threads at 2000 RPM. The chasers, which have ground thread forms, are available for selected applications on turret lathes, automatics and threading machines. **T-10-15**

Solenoid Selector Valve

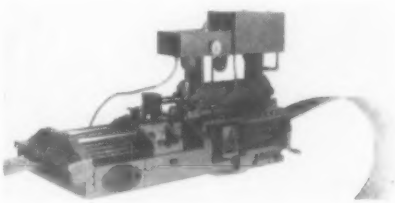
Saval, Inc., 1915 East 51st Street, Los Angeles 11, Cal., announces a line of AC solenoid operated 4-way Selector Valves designed for service with water, oil or air at operating pressures to 250 psi and converitble for DC operation merely by changing solenoids. The series includes pipe sizes of ¼, ⅜, ½, ¾ and 1 in.



Features claimed for this No. 8900 series are leak-proof, "Shear-Seal" design; simplicity—only one moving part; direct operation, thus eliminating pilot operation; fast, positive action under all conditions; and ease of installation. **T-10-16**

Air-Operated Slide Feed

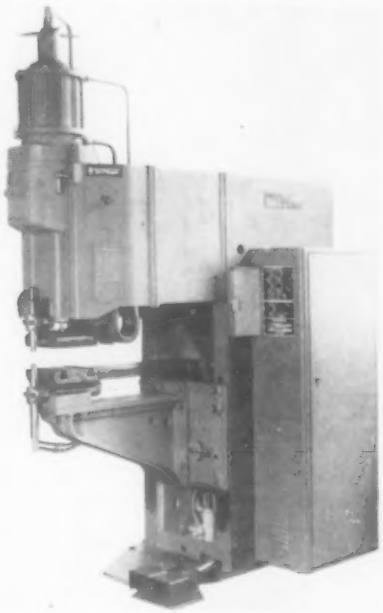
An air-operated Slide Feed for punch presses, by U. S. Tool Company, Ampere, N. J., is a self-contained unit requiring no mechanical connections to the press beyond adjacent mounting. Therefore, it can be used with all types of equipment requiring strip feeding, and may be moved from machine to machine.



The air feed can be used semi-automatically or may be made fully automatic by incorporating interlocking switches; also, practically unlimited feed lengths are said to be obtainable by making multiple strokes with feed timed to coincide with a stroke of the machine. Accuracy within 0.002 in. is claimed for each stroke of the feed. **T-10-17**

Tri-Phase Welders

Tri-Phase Welders, by Taylor-Winfield Company, Warren, Ohio, have been developed to provide balanced power and to overcome power supply difficulties. Claimed are a desirable high power



factor—95%—at greatly reduced power demand and more production or heavier welding with present power installations. Design permits wide range of shapes and work to be welded, especially for deep-throat welding. **T-10-18**

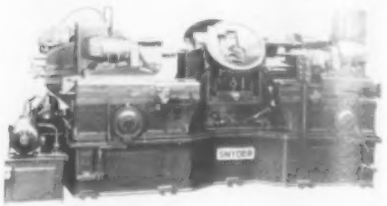
Instantaneous Reset Timers

A series of PAC Timers, by Industrial Timer Corporation, 115 Edison Place, Newark, N. J., are designed for hard usage in modern manufacturing processes. The series ranges from the PAC 5S, with a timing range from 5 cycles to 5 seconds, calibrated in 5 cycle steps, to the PAC-3H, with a range from 2 minutes to 3 hours, calibrated in 2 minute steps.

Features include instant automatic reset, whereby a spring returns the actuating arm as soon as the clutch is released and a time setting adjustment. **T-10-19**

Line Drill & Boring Machine

A machine which drills and line bores cross shaft holes in 70 different sizes and types of clutch housings is a recent development by Snyder Tool & Engineering Co., E. Lafayette, Detroit, Mich.



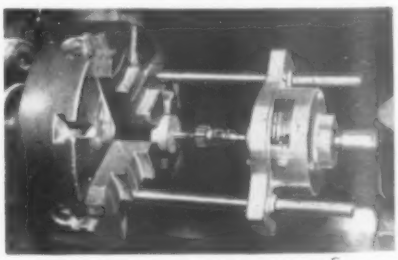
A work piece is manually clamped in each of two stations on a manually rotated Snyder standard index table, mounted centrally between the slides. The two stations permit drilling and boring operations to be performed simultaneously.

Four hydraulically actuated Snyder standard slide units, moving on hardened and ground ways, are mounted horizontally and opposed in pairs, front and rear. The two rear slides are equipped with single spindle drill heads, and are used to drill the cross shaft holes, while the two front slides are equipped with Parker boring spindles for finish line boring the holes. These front spindles are provided with micrometer adjustment permitting precision setting of the finish boring tools, which are tungsten carbide.

Drilling and boring spindles are driven by a Reliance "V-S" Drive which permits spindle RPM to be changed to suit the size of the tools being used, and slide feed rates are controlled by individual feed control valves. Estimated production is 65 pieces an hour at 80% efficiency. T-10-20

Turret Lathe Tapping Head

Errington Mechanical Laboratory, Inc., Staten Island 4, N. Y., announces the Errington Auto-Reverse Turret Lathe Tapping Head, which permits tapping the hole and backing out the tap without stopping the work or reversing the machine in a turret lathe setup. To operate, simply feed the tap into, and out of, the drilled hole while the work is turning in the one direction. With the aid of a friction chuck, blind holes are said to be tapped without tap breakage.



The tapping head can also be used on drill press work for production-tapping. For this, the tool has a 2 to 1 reverse, and uses guide-bars to hold and steady the case. T-10-21

Multiple Tapping Machine

A special machine, announced by the Cross Company, Detroit 7, Mich., is designed to tap 60 holes in an automatic transmission case at the rate of 65 pieces hourly.

Work cycle is automatic and push-button controlled. 25 holes are tapped at Station No. 1, after which an automatic shuttle carries the part to Station 2, where 35 more holes are tapped. The part is then returned for unloading.

Each tapping spindle is equipped with an individual lead screw feed, with a safety device to eliminate tap breakage if holes have not been drilled in the previous operation, and with a lubricating system which provides a measured amount of oil with every cycle. Since the machine is designed for moderate production, unnecessary features have been eliminated to provide a special machine offering many manufacturing advantages at low original investment. **T-10-22**

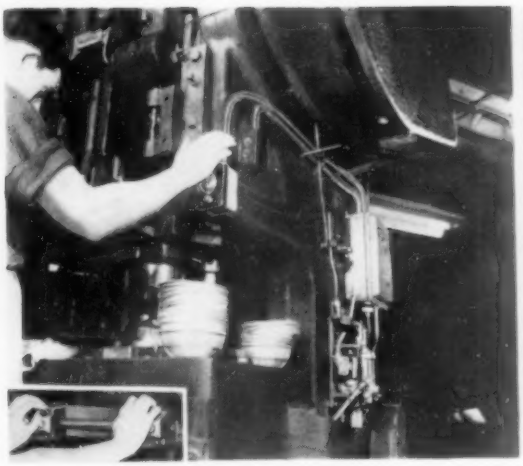
Carbide Cutting Alloy

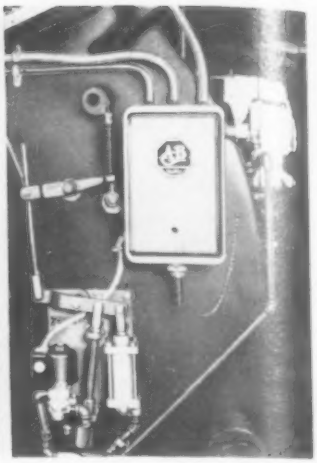
Development of a sintered carbide alloy, especially designed for high speed planer tools, is announced by the Carbide Alloys Division of Allegheny Ludlum Steel Corporation.

The alloy, which was developed with the cooperation of manufacturers of high speed planers, is now available on a commercial basis under the trade name Carmet Grade CA-51, and the blanks can be supplied for planers using either the "clamped in" or brazed type blanks.

A series of tests with the new metal has led to claims that the alloy has a number of important merits. The following data were compiled from a typical test with a planer using "clamped in" blanks.

Material cut....60 percent semi-steel casting
Depth of cut.....Up to 1½ inches
Feed.....100 inch
Surface speed....175 feet per minute
Metal removed..As much as 2100 lbs. per grind of tool.





Punch Press Guard

An air and electrically operated Punch Press Guard—Model A-E No. 100, by Graham Specialty Company, 12925 Auburn Ave., Detroit 23, Mich.—is primarily designed for any size inclinable, direct clutch press that does not require more than 150 lbs. pull to operate the present foot trip.

The conventional foot treadle is replaced by an air thruster, and push buttons are located so that one hand must be used for each button. The circuit is completed only by pushing both buttons, when the air thruster releases the clutch and allows ram to make one complete cycle. Both hands are therefore out of danger, yet free to pick up the next workpiece.

Unless the solenoid valve is re-energized by use of both start buttons, an anti-repeat switch allows the ram to descend once only; however, plugging in a foot attachment—for blanking of long stock—permits automatic action and makes the start buttons inactive.

Micro-switches, installed in the circuit, permit operation of inter-locking dies so that the press cannot operate unless work or die are in "home" position. Standard equipment includes the air-thruster, anti-repeat switch, anti-repeat cam, contactor and start buttons and complete instructions. T-10-23

Air Pressure Regulators

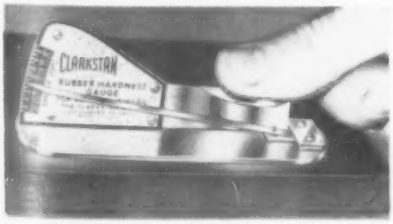
Two air pressure regulators, designated as Series PRD and Series LRD, which are designed for specific applications on compressed air supply lines are announced by Hannifin Corporation, Chicago builder of pneumatic and hydraulic production equipment. Series PRD regulators are equipped with a flange for panel mounting where the adjusting knob extends through to the front of an instrument board, while the valve itself is back of the board for convenience in making pipe connections.

Series LRD regulators are for installations where it is desirable to lock the adjusting knob against unauthorized change of pressure setting. Locking is accomplished with any common type of padlock by passing the hasp through matching holes in two parallel discs. The lower disc, carrying four holes, is attached in a stationary position to the body of the regulator, while the upper disc is keyed to and turns with the adjusting knob. The disc arrangement provides 36 possible locking combinations and very fine pressure adjustment.

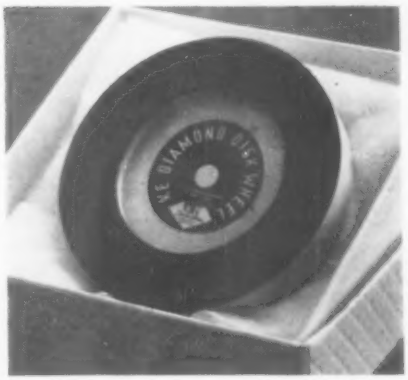
Specifications and dimensions for the new regulators are contained in data sheets which may be obtained by writing to Hannifin Corporation, 1101 S. Kilbourn Ave., Chicago 24, Ill. **T-10-24**

Gage for Elastometers

The Clarkstan Corp., 11927 W. Pico Blvd., Los Angeles, Cal., announces a low-cost rubber gauge designed to accurately measure the hardness of rubbers and other elastometers from 15 to 95 shore. Of convenient pocket size, with finish of hard polished chromium, the gage has only one moving part without linkage and is said to always repeat. Each unit is supplied with a test block of known shore hardness. **T-10-25**



Diamond Disk Wheel



A diamond disk wheel that is said to combine high efficiency with lower cost has recently been placed on the market by K-E Industries of Minneapolis, Minnesota.

A diamond face, that may be replaced at low cost, makes it possible to increase efficiency and to lower costs on grinding operations requiring the use of diamond wheels.

The lower cost of the K-E products brings them within the range of use by small shops as well as large industrial plants. They may be used on ordinary bench grinders as well as carbide tool grinders.

Complete information may be had from K-E Industries, 253 Plymouth Building, Minneapolis 2, Minn. **T-10-26**

Filing Machine Has All-Purpose Overarm

This Milwaukee bench-type reciprocal filing machine, Model FS, performs all three die making operations, filing, sawing and lapping, without changing overarms. A deep-throated, all-purpose overarm equipped with an upper chuck in the overarm assembly makes it possible to chuck files, saws or lapping sticks at the upper, as well as the lower end. Spring tension on saws and thin files is readily adjusted by moving overarm chuck assembly up or down.

Another advantage provided by the overarm is the fact that it permits chucking close to the work piece, thereby assuring rigidity of saws and files.

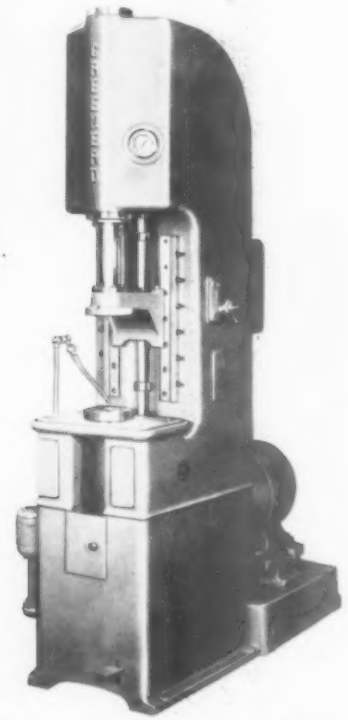
The lower chuck is another feature of this machine which promotes precision workmanship. A ball joint permits accurate alignment of files with warped, crooked or twisted shanks before they are rigidly clamped in working position. Caps have serrated faces, with V-grooves, to firmly grip and align files, saws or stones of any size or shape.

The Model "FS" Milwaukee die filer and a companion machine, Model "F," recommended for filing only are manufactured by the Rice Pump and Machine Co., Milwaukee, which also manufactures the Milwaukee profile grinder. New, illustrated bulletins covering all three machines are now available.

Broaching and Guided Assembly Press

Greenerd Arbor Press Company has designed a broaching and guided assembly press designed for rugged service with a minimum of deflection for broaching and assembly operations.

A ground alloy steel ram is guided on heat treated and ground ways on the press, to insure accurate ram travel. The cylinder is honed to size and fitted with cast iron rings, and the ram is sealed with chevron type asbestos and neoprene packings.



Ram speeds of the press is adjustable from 20 to 300 in. per min., with a return speed at a rate of 460 in. per min. The new model, the G6-S-W-C has a maximum pressure of six tons, with adjustments possible for a range from $\frac{3}{4}$ ton to the full six tons. Other features include 10 hp motor, interconnected through three V-belts with hydraulic pump; daylight range from 3 in. to 21 in.; ram travel adjustable from one to 18 in.

Further information may be had by requesting bulletin 357.28.

Utility Bench Grinder

A precision built 6 in. utility bench grinder with a fully enclosed motor of the permanent split capacitor type has just been announced by the K. O. Lee Co., of Aberdeen, So. Dakota.

The company claims this type motor will stand severe usage without breakdown or burn-out. Standard equipment includes 2 grinding wheels, fine and coarse, adjustable tool rests and a "K-O" abrasive wheel dresser.

For further details write K. O. Lee Co., Dept. TE, Aberdeen, So. Dakota.

Solenoid Valve

A new 4-way solenoid valve has been announced by Hanna Engineering Corp., Chicago manufacturers of hydraulic and pneumatic cylinders, valves and riveters. The small, compact unit is of the balanced spool type, controlled by a built-in solenoid pilot valve.

A practical manifold design permits flexibility in piping arrangement—lines may be connected to bottom sides or a combination of both, as desired.

The Hanna Valve is adaptable to straight line piping, with valve capacity equal to rated pipe size. Valves and manifolds are interchangeable and the valve proper may be removed from manifold without disconnecting pipe lines.

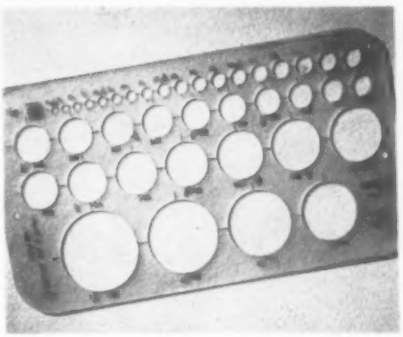
Other features of the Hanna Solenoid Valve include: Only 5/32" solenoid stroke, silent mechanical operation, low current consumption, valve proper made of corrosion resistant materials, and time required for pushbutton response or each strike of valve spool only 1/20 second. Valves are precision-built for lasting service. **T-10-27**

Circular Form Tool Blanks

The Production Service Co., 1060 Broad Street, Newark 2, N. J., have developed a complete line of Circular Form Tool Blanks, to be used for circular tools on all types of automatic screw machines. These blanks, furnished with right or left-hand threads, are made from a standard brand 18-4-1 high speed steel, can be furnished soft or hardened to 64-65 Rockwell "C," and are available from stock. **T-10-28**

Circle Template

Rapidesign, Inc., Box 592, Glendale, Calif., announces the No. 40 circle template for use in all fields of drafting and delineation.



This template is the answer to the ever present problem of quick, accurate, small size circles. Thirty-nine circles are grouped in progressive sizes with increments in 64ths, 32nds, 16ths and 8ths of an inch.

The No. 40 Circle Template is made of .020, matte finish, mathematical-quality, cellulose nitrate sheet.

All circle cut outs are precision milled with allowance for pencil point to give the utmost in accuracy. Each circle is clearly marked and all have center guide lines. Printing is on negative side to prevent wearing off. **T-10-29**

Universal and Plain Milling Machines

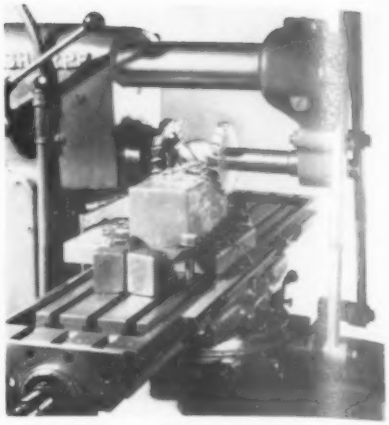
Designed to take heavier cuts than the well-known Brown & Sharpe light types, these milling machines have an increased vertical capacity, a No. 50 milling machine standard taper hole in spindle, suitable spindle speeds for larger cutters and ample rigidity for using the greater power.

Full 5 hp, all-gear drive is provided to cutters. Cutting feed and fast travel are independently all-gear driven by a ¾ hp motor synchronized with spindle motor. Fast travel of 75 in. per min. in all directions, is available with spindle rotating or stopped. A single lever selects any of the 18 spindle speeds from 30 to 1200 r.p.m. Power is imparted to the spindle at all speeds directly back of the front bearing mounting.

A single lever also selects any of the 18 cutting speeds in the useful range of ½ in. to 20¼ in. per min., uniform in all directions.

The coolant system is operated by a ¼ hp motor-driven centrifugal pump which automatically stops when the spindle stops and may be disconnected by a switch when not required.

These 5 hp machines offer the many advantages of the extended spindle face design with the spindle nose extending



forward more than 3 in. from conventional position. This brings the front spindle bearing nearer the center of the table, reducing overarm and arbor lengths, and gives greater rigidity of cutter support. Ability to mount cutters closer to the spindle nose reduces cutter and arbor vibration and cutter wear.

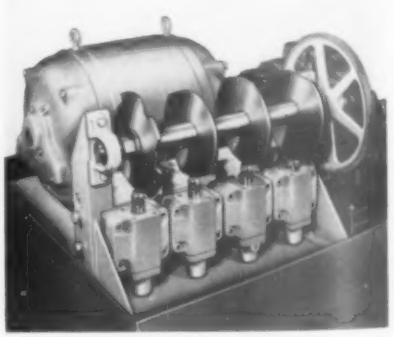
When attachments are used on the extended spindle face of the 5 hp machines, greater rigidity is secured with no loss of throat distance.

The Universal and Plain machines have a longitudinal feed of 28 in., transverse feed of 10 in., and vertical feed of 16½ in. The Universal weighs approximately 4700 pounds and the Plain, 4440 pounds. T-10-30

Mechanical "Brain"

Originally designed for use with Hufford hydraulic presses, this mechanical "Brain" is adaptable to widely varying types of hydraulic equipment. It produces a series of accurately timed repetitive motions to multiple ram installations utilizing hydraulic cylinders.

The Hufford mechanical "Brain" employs a series of specially designed cams which are machined for specific operations. The cams are mounted on a single shaft which is motor driven through a hydraulic transmission.



As the cams rotate they depress the roller-bearing stems of actuating valves, thus permitting or cutting off the flow of hydraulic fluid operating the cylinders. Since there are no solenoids or intricate valve parts, maintenance is held to a minimum. Detailed information is available by writing Hufford Machine Works, Inc., Redondo Beach, California. T-10-31

Short Series Holder

A short series holder for use with standard core drill cutters is announced by the Eclipse Counterbore Company of Detroit, Michigan.

The short series consists of four sizes only, the smallest holder being $1\frac{1}{4}$ in. in diameter. This takes Eclipse standard core drill cutters from $1\frac{1}{2}$ in. to $1\frac{13}{16}$ in. diameter. The next size is $1\frac{1}{2}$ in., and accommodates cutters from $1\frac{7}{8}$ in. to $2\frac{5}{16}$ in. The third size is $1\frac{3}{4}$ in. in diameter. This holder drives cutters from $2\frac{1}{4}$ in. to $2\frac{9}{16}$ in. while the largest holder, 2 in. in diameter, takes cutters from $2\frac{5}{8}$ in. to 3 in. inclusive.

Since the average core drilling operations done on turret lathes are relatively shallow, the short series core drill holder is especially adaptable in that it eliminates the extra time and effort on the part of the operator, which is required to back the turret away to clear the longer holder when indexing. The plain or stub holder affords a greater rigidity and is more economical since the expensive operation of milling the long flutes and grinding the outside diameter and the flute faces is eliminated.

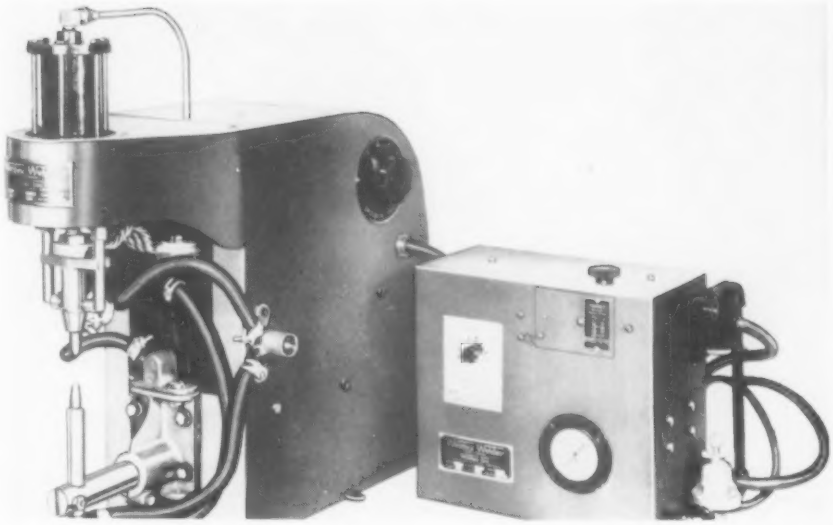
Hard Surfacing Electrodes

To extend its line of hard facing electrodes The Lincoln Electric Co., Cleveland, Ohio, is now producing two electrodes of the coated tubular type for depositing abrasion resisting surfaces of weld metal. Tubular electrodes are steel tubes in which is contained the hard surfacing alloy in a concentrated form.

Tungweld-C is a tubular, light coated electrode which contains in the tube coarse particles of tungsten carbide. The particles are deposited by the arc in the weld crater and as the weld solidifies are held in a tough iron alloy matrix.

Tungweld-C is recommended for use for surfacing earth cutting tools when a jagged, rough, self-sharpening edge is required, and for facing other tool surfaces to resist extremely severe abrasion.

Tungweld-F is a shielded arc tubular electrode containing fine particles of tungsten carbide. It is for use on earth cutting tools but produces a smoother, thinner and sharper edge than the rough edge of Tungweld-C. **T-10-32**



Bench Type Spotwelder

For joining small metal parts, Weldex Inc., Detroit, Michigan, has introduced an automatic $7\frac{1}{2}$ KVA bench type spotwelder, Model 752-PB. The welder is engineered to handle light non-ferrous metals of the same or dissimilar alloy and thickness, on a production basis, and will also give efficient, low-cost operation on ferrous metals up to two thicknesses of 14 gauge CRS or equivalent.

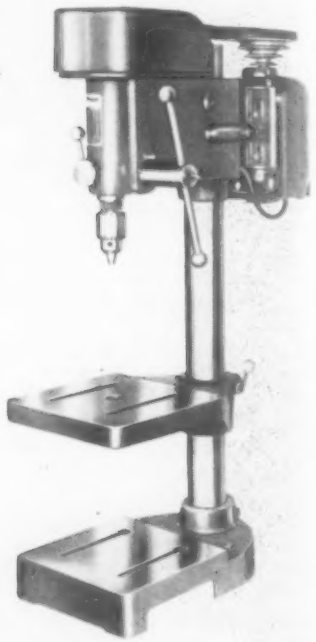
In addition to air strainer, regulator, gauge and lubricator standard equipment includes: a built in four-step transformer tap changing switch; single acting air cylinder; magnetic long-life contactor; and electronic timer. Regularly furnished for 220 volt, 60 cycle, single phase A.C. operation, this model is also available in 380 or 440 volts on special order.

Standard throat depth is $4\frac{1}{2}$ in. Complete with separate control cabinet the whole unit occupies less than two square feet of bench space.

Price information and other data are available by writing Dept. K., Weldex Inc., 7338 McDonald Avenue, Detroit 10, Mich. **T-10-33**

15-Inch Drill Press

A 15 in. Drill Press, added to its line of industrial tools by the Reypo Corporation, 5751 West 98th St., Los Angeles 45, Cal., features a depth stop which operates directly on the feed pinion between the two lower quill bearings, thus eliminating any side thrust or consequent deflection of drill point. The quick setting gauge is calibrated in sixteenths.



The spindle has a travel of 4 in., with four speeds from 630 to 4850 RPM, and free floating drive is designed to prevent whip or misalignment. Drive is through involute splines and mating involute keys. Both table and base have ground working surfaces and are provided with parallel slots for ½ in. bolts.

T-10-34

Bare Bronze Wire for Submerged-Arc Welding

Users of the submerged-arc process of welding can now obtain a recently developed bronze bare wire in coils that is satisfactory for overlaying large steel areas for bearing, wear- and corrosion-resistant service or for joining aluminum bronze.

The wire is called Ampco-Trode 10 bare wire and is produced by Ampco Metal, Inc., Milwaukee 4, Wisconsin, for use in steel mills, railroad shops, etc.

Ampco-Trode 10 bare bronze wire is supplied in coils in ⅛ in. and $^{3}/_{16}$ in. diameter sizes for use with the submerged-arc process. The finished wrapped coils have a 22 in. inside diameter wound left hand to turn off a vertical reel counter-clockwise without snagging when pulled from the starting end.

Additional technical information, recommended melts, physicals, etc., may be obtained on request from Ampco Metal, Inc., Milwaukee 4, Wisconsin.

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Second Monday *
George A. Irwin, *Chairman*
243 Malacca Ave.
Akron, Ohio

ATLANTA, NO. 61
Third Monday *
George W. Brown, *Chairman*
Big A. Road,
Toccoa, Ga.

BALTIMORE, NO. 13
First Wednesday *
George A. Exley, *Chairman*
Bendix Radio Div.
E. Joppa Road, Towson
Baltimore 4, Md.

BINGHAMTON, NO. 35
Second Wednesday *
Roger E. Coles, *Chairman*
506 Mountain View Dr.,
Union, N. Y.

BOSTON, NO. 33
Second Thursday *
William W. Young, *Chairman*
Pratt & Whitney Div.
238 Main St.,
Cambridge, Mass.

BUFFALO-NIAGARA FRONTIER, NO. 10
Second Wednesday *
Garrett Kingston, *Chairman*
38 Schauf St.,
Buffalo 11, N. Y.

CEDAR RAPIDS, NO. 71
Third Wednesday *
Raymond E. Bextine, *Chairman*
Link-Belt Speeder Corp.
1201 Sixth St., S. W.,
Cedar Rapids, Iowa

CENTRAL PENNSYLVANIA NO. 22
Third Thursday*
Albert Anderson, *Chairman*
446 N. Duke St.,
Lancaster, Pa.

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First Monday *
Harold M. Taylor, *Chairman*
Supplies, Inc.
564 W. Adams St.,
Chicago 6, Ill.

CINCINNATI, NO. 21
Second Tuesday *
George H. Simon, *Chairman*
7 W. Pike St.,
Covington, Ky.

CLEVELAND, NO. 3
Second Friday *
Jack H. Schron, *Chairman*
Glenn Tool & Mfg. Co.
716 E. 163rd St.,
Cleveland 10, Ohio

COLUMBUS, NO. 36
Second Wednesday *
Albert W. Montague, *Chairman*
829 Vernon Rd.,
Columbus 9, Ohio

DAYTON, NO. 18
Second Monday *
E. J Seifreat, *Chairman*
1006 Harries Bldg.,
Dayton, Ohio

DECATUR, NO. 58
Second Monday *
Fred W. Sobottka, *Chairman*
1620 E. Cleveland Ave.,
Decatur, Ill.

DENVER, NO. 77
First Wednesday *
Ben J. Hazewinkel, *Chairman*
2355 Jasmine St.,
Denver 7, Colo.

DETROIT, NO. 1
Second Thursday *
Andrew Carnegie, *Chairman*
2970 W. Grand Blvd.,
Detroit 2, Mich.

ELMIRA, NO. 24
First Monday *
James F. Deegan, *Chairman*
Lower Maple Ave.,
Elmira, N. Y.

ERIE, NO. 62
First Tuesday *
Vincent Peck, *Chairman*
1110 W. 30th St.,
Erie, Pa.

EVANSVILLE, NO. 73
Second Monday *
Clyde E. Yost, *Chairman*
700 Villa Dr.,
Evansville, Ind.

FAIRFIELD CTY., NO. 6
First Wednesday *
William C. McDonough, *Chairman*
R.F.D. 2, Danbury Rd.,
Wilton, Conn.

FLINT, NO. 68
Third Thursday
Ralph W. Cook, *Chairman*
1037 Gladwyn,
Flint 4, Mich.

FOND DU LAC, NO. 45
Second Friday *
Jule P. Schommer, *Chairman*
59 Polk St., Oshkosh, Wis.

FORT WAYNE, NO. 56
Second Wednesday *
Leonard Roebel, *Chairman*
206 E. Sherwood Terrace,
Ft. Wayne, Ind.

FOX RIVER VALLEY, NO. 72
First Tuesday *
Roger F. Waindle, *Chairman*
123 So. Jackson Ave.,
Batavia, Ill.

GOLDEN GATE, NO. 28
Third Tuesday *
Ernest C. Holden, *Chairman*
3122 Guido St.,
Oakland 2, Calif.

HAMILTON, NO. 42
Second Friday *
Gordon Hall, *Chairman*
29 Nelson Ave.,
Burlington, Ont.

HARTFORD, NO. 7
First Monday *
William F. Jarvis, *Chairman*
Chas. L. Jarvis Co.
Pease Ave.,
Middletown, Conn.

HOUSTON, NO. 29
Second Tuesday *
Dean Saurenman, *Chairman*
Baker Oil Tools, Inc.
Box 3048, Houston 1, Texas

INDIANAPOLIS, NO. 37
First Thursday *
Clarence M. Wetzel, *Chairman*
4910 E. 12th St.,
Indianapolis, Ind.

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First Wednesday *
F. Ward Osborn, *Chairman*
819 West College,
Independence, Mo.

LITTLE RHODY, NO. 53
Third Wednesday *
Robert B. Parker, *Chairman*
76 Ferncrest Ave.,
Edgewood, R. I.

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Second Thursday *
Leslie F. Hawes, *Chairman*
2616 W. 78th Pl.,
Inglewood, Calif.

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Second Wednesday
John A. Black, *Chairman*
3733 N. Western Pkwy.,
Louisville 12, Ky.

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1st Tues. After 1st Mon. *
Lorenz A. Leifer, *Chairman*
13 Oxford Pl.,
Madison 4, Wis.

MID-HUDSON, NO. 74
Second Tuesday *
Llewellyn H. Tenney, *Chairman*
76 Grand Ave.,
Poughkeepsie, N. Y.

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Second Thursday *
Joseph Ebner, *Chairman*
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Milwaukee, Wis.

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1135 Joliette
Coteau Rouge Rd.,
Longueuil, Que.

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Second Wednesday *
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1212 Bundy Court,
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1513 Ashwood Ave.,
Nashville, Tenn.

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Second Thursday *
Alton V. Pollard, *Chairman*
American Brass Co.
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Second Wednesday *
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6574 General Haig,
New Orleans 19, La.

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First Monday *
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630 Victory Blvd., Grymes Hill,
Staten Island, N. Y.

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62 Thomas St.,
St. Catharines, Ont.

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2700 Western Ave.,
Fort Worth 7, Texas

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Second Tuesday *
Charles B. Carlson, *Chairman*
Ediphone Division
Thomas Edison, Inc.
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214 Weiman Ave.,
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Third Thursday *
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5865 Hadfield St.,
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Walter S. Risser, *Chairman*
1332 Franklin Ave.,
Pittsburgh 21, Pa.

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Third Thursday *
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Warren, Mich.

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Twin City Machine Co.
31 Mechanics Row
Auburn, Maine

PORTLAND (OREGON), NO. 63
Last Tuesday *
Everett Werner, *Chairman*
2919 S.E. Clay Ave.,
Portland 15, Ore.

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William Reinhardt, Jr., *Chairman*
837 Blaine Blvd.,
Racine, Wis.

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Second Tuesday *
Ralph McKee, *Chairman*
Webster, Ind.

ROCHESTER, NO. 16
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H. O. Simon, *Chairman*
94 Harvington Dr.,
Rochester 12, N. Y.

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First Thursday *
H. A. Nelson, *Chairman*
Barber Colman Co.
150 Loomis St.,
Rockford, Ill.

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First Thursday *
Harrel M. Creasey, *Chairman*
Box 708-6, Route 6,
Sappington 23, Mo.

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Second Tuesday *
Raymond W. Peters, *Chairman*
6952 Fitch Court,
San Diego 11, Calif.

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Second Thursday *
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1448 Myron St.,
Schenectady 8, N. Y.

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Second Tuesday *
Clyde A. Peterson, *Chairman*
Rt. 2, Box 210
Bellevue, Wash.

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Second Tuesday *
Norman R. Smith, *Chairman*
3941 Cottage Ave.,
Mishawaka, Ind.

SPRINGFIELD (ILLINOIS), NO. 64
First Tuesday *
H. C. Chambers, *Chairman*
1817 Dial Court,
Springfield, Ill.

SPRINGFIELD (MASS.), NO. 32
Second Monday *
George R. Brown, *Chairman*
52 Barber St.,
Springfield, Mass.

SPRINGFIELD (OHIO), NO. 76
Fourth Thursday *
Joseph E. Charters, *Chairman*
The Oliver Corp.
270 Monroe St.,
Springfield 99, Ohio

SYRACUSE, NO. 19
Second Tuesday *
Lester H. Collins, *Chairman*
177 Ridgeway Ave.,
Syracuse, N. Y.

TOLEDO, NO. 9
Second Wednesday *
Lawrence F. Rothert, *Chairman*
6021 Acres Rd.,
Sylvania, Ohio

TORONTO, NO. 26
First Wednesday *
John W. Lengbridge, *Chairman*
41 Kelso Ave.,
Toronto 12, Ont.

TRI CITIES, NO. 23
First Wednesday *
E. B. Benson, *Chairman*
2440 27th St.,
Moline, Ill.

TWIN CITIES, NO. 11
First Wednesday *
Harold D. Sullivan, *Chairman*
4038 28th Ave. S.
Minneapolis 6, Minn.

TWIN STATES, NO. 40
Second Wednesday *
W. C. Hadfield, *Chairman*
33 Pine St., Springfield, Vt.

WESTERN MICHIGAN, NO. 38
Second Monday *
Edmund E. Cedarquist, *Chairman*
523 Fremont Ave. N.W.,
Grand Rapids 4, Mich.

WICHITA, NO. 52
Second Wednesday *
Leigh S. Icke, *Chairman*
657 N. Terrace Dr.,
Wichita 6, Kansas

WILLIAMSPORT, NO. 49
Second Monday *
Delbert M. Lowrey, *Chairman*
1233 Park Ave.,
Williamsport, Pa.

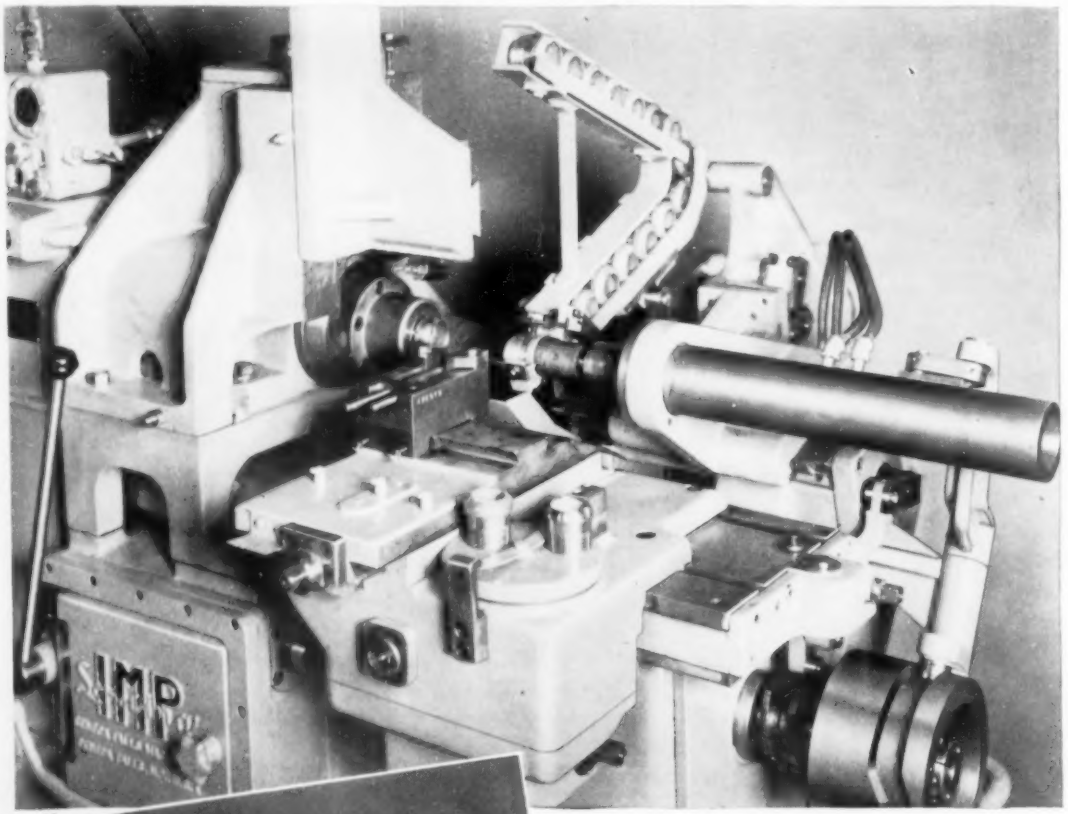
WINDSOR, NO. 55
Second Monday *
Alfred J. Hodgins, *Chairman*
995 Lawrence Rd.,
Windsor, Ont.

WORCESTER, NO. 25
First Tuesday *
Ralph E. Rawling, *Chairman*
22 Elm St., Shrewsbury, Mass.

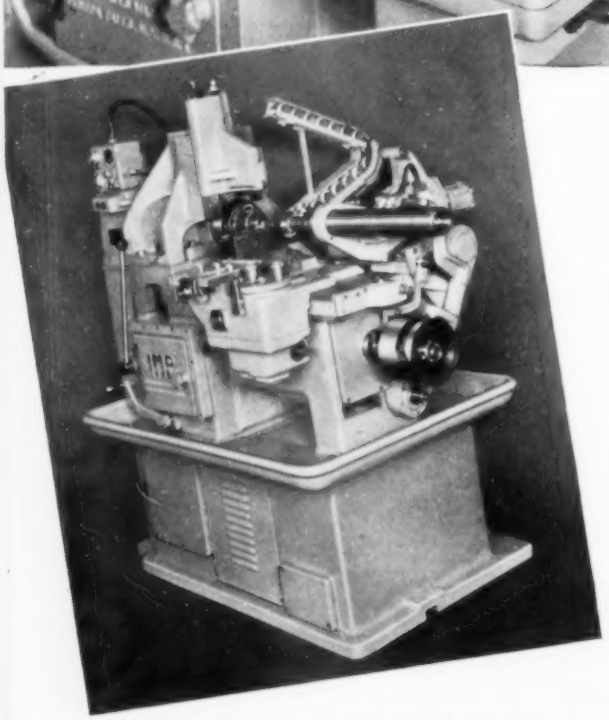
*** CHAPTER MEETING NIGHT**

MACHINE OF THE MONTH

PREPARED BY THE SENECA FALLS MACHINE CO. **"THE Lo-swing PEOPLE"** SENECA FALLS, NEW YORK



The close-up view of the machine shows the cams (covers removed) which operate the automatic loader and which assure perfect timing of all movements.



Lo-swing Lathes fitted with Automatic Loaders are usually grouped together in series of two or more as one operator can easily keep the loading chutes on several machines filled.

AUTOMATICALLY LOADED Lo-swing IMP

TURNS BRONZE COUPLINGS AT FAST RAT

Problem: To finish turn spherical end of bronze coupling. Operation consists of turning outside diameter, forming larg radius, facing inside shoulder, and chamfering inside diamete

Solution: The fully-automatic Lo-swing IMP Lathe selecte for this job was fitted with a new type loader, designed for han ling fairly heavy castings. The machine is entirely automati Bronze couplings which have been previously turned an threaded on the small end are placed in the loading chute an fed by gravity into a cradle where they are picked up by the in jector head and chucked in an air-operated collet chuck. Turnin of the O. D. and chamfering of the I. D. are accomplished wit two tools mounted on the front slide, while squaring of th shoulder and forming of the radius are done with two too mounted on the vertical slide. The finished piece is then automa ically ejected and picked up by a safety finger which in turn drop it on the evacuation chute. The cycle is then repeated. A hig hourly production is maintained due to the rapid operation o the automatic loader.

SENECA FALLS MACHINE CO., SENECA FALLS, N. Y.

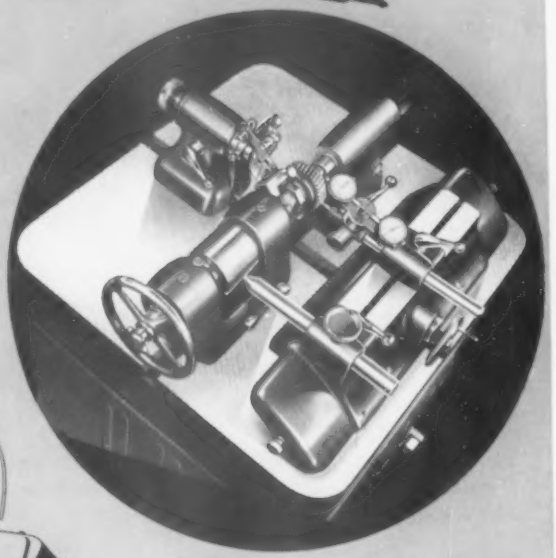
PRODUCTION COSTS ARE LOWER WITH Lo-swing

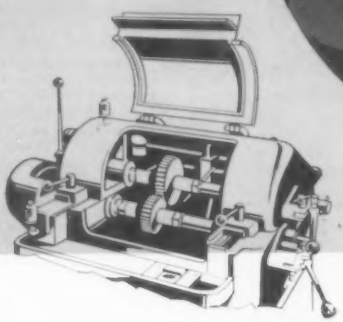
Check For Gear Errors and Test for Gear Noise

The accuracy of the Red Ring Universal Gear Checker classifies it as tool room equipment. At the same time its operation is simple enough for the average machinist to quickly get an accurate check of index, helical angle, eccentricity, lead, tooth size, wobble and tooth parallelism. It will save a lot of scrap when it's available to the operators of production machines.

The Red Ring Gear Sound Tester segregates noisy gear sets before they are assembled, thus saving whatever time is needed to disassemble and reassemble them after being corrected.

The construction of the sound chamber and horn is such that this unit may be successfully used even in a noisy shop. Mating gears are run together under conditions similar to those of actual service.





Write for descriptive literature and prices

2872

NATIONAL BROACH AND MACHINE CO.
5600 ST. JEAN . . . . . DETROIT 13, MICHIGAN

Statement of Ownership

STATEMENT of the Ownership, Management, Circulation, etc., required by the Acts of Congress of August 24, 1912, and March 3, 1933, of The Tool Engineer, published monthly at Detroit, Michigan, for October 1, 1948.

State of Michigan, County of Wayne—ss.

Before me, a notary in and for the State and County aforesaid, personally appeared Robert B. Powers, who, having been duly sworn according to law, deposes and says that he is the Publisher of The Tool Engineer and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, executive editor, technical editor, and business manager are: Publisher, American Society of Tool Engineers, 1666 Penobscot Bldg., Detroit 26, Mich. Executive Editor, Robert B. Powers, 550 W. Lafayette Blvd., Detroit 26, Mich. Technical Editor, A. E. Rylander, 550 W. Lafayette Blvd., Detroit 26, Mich. Production Manager, James Curran, Jr., 550 W. Lafayette Blvd., Detroit 26, Mich.

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5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the twelve months preceding the date shown above is—(This information is required from daily publications only.)

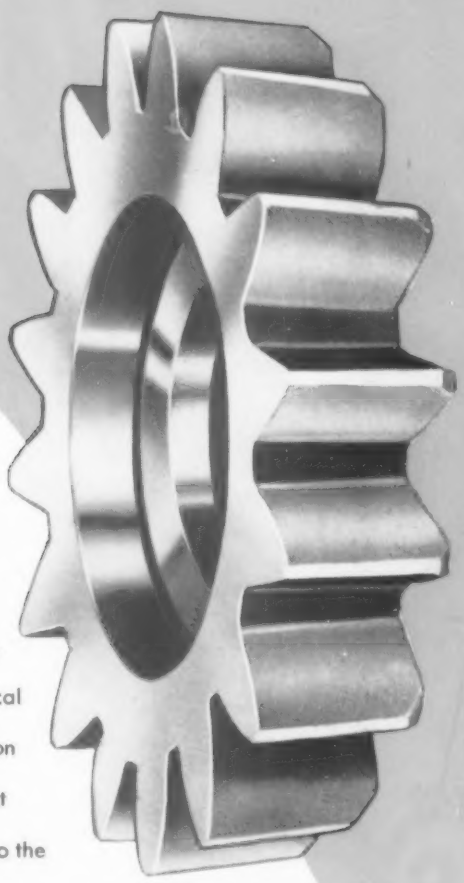
Signature of editor, publisher, business manager, or owner. Robert B. Powers. Sworn to and subscribed before me this 1st day of October, 1948. Doris B. Pratt. My commission expires May 12, 1952.

Please Change Your Records. . .

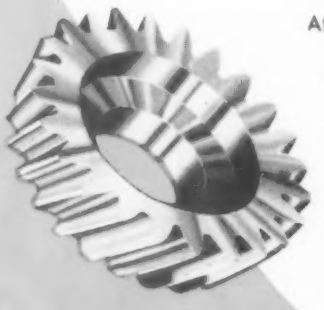
After November 1st
National Headquarters
of
The American Society
of
Tool Engineers
will be in our new building
10700 Puritan Avenue
Detroit 21, Michigan

SHAPER CUTTERS by ILLINOIS TOOL

"application-engineered" for maximum production efficiency

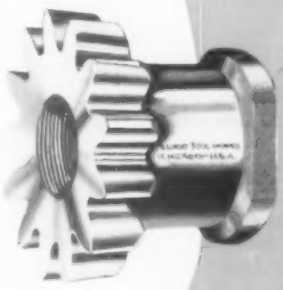


Individual tool engineering, expert design and metallurgical analysis for specific application requirements, is an essential first step in assuring maximum tool life . . . particularly vital to the performance of your gear shaper cutters and the gears or splines you produce.



At Illinois Tool Works, experienced cutting tool specialists work closely with your engineers to assure this necessary specific design attention.

Illinois Tool gear shaper cutters are produced for maximum operating economy. The shaper cutters illustrated above are but a few of the many produced at Illinois Tool Works for the manufacture of almost every type of gear.



Whatever your application, let Illinois Tool engineers help design your gear shaper cutters . . . write today.

FREE

This illustrated manual has been prepared by Illinois Tool Engineers to serve gear designers with a quick summary of the important fundamentals involved in the design and production of gears. Write for your free copy of "Design of Gear Teeth" now.

ILLINOIS

2501 North Keeler Avenue, Chicago 39, Illinois
In Canada: Canada Illinois Tools, Ltd., Toronto, Ontario

Headquarters for Engineered Cutting Tools

50 years

WARREN AXE AND TOOL CO.
MANUFACTURERS OF SUPERIOR QUALITY AXES AND TOOLS
WARREN, PENNSYLVANIA, U.S.A.

May 5, 1948

Cincinnati Planer Co.
Cincinnati, Ohio

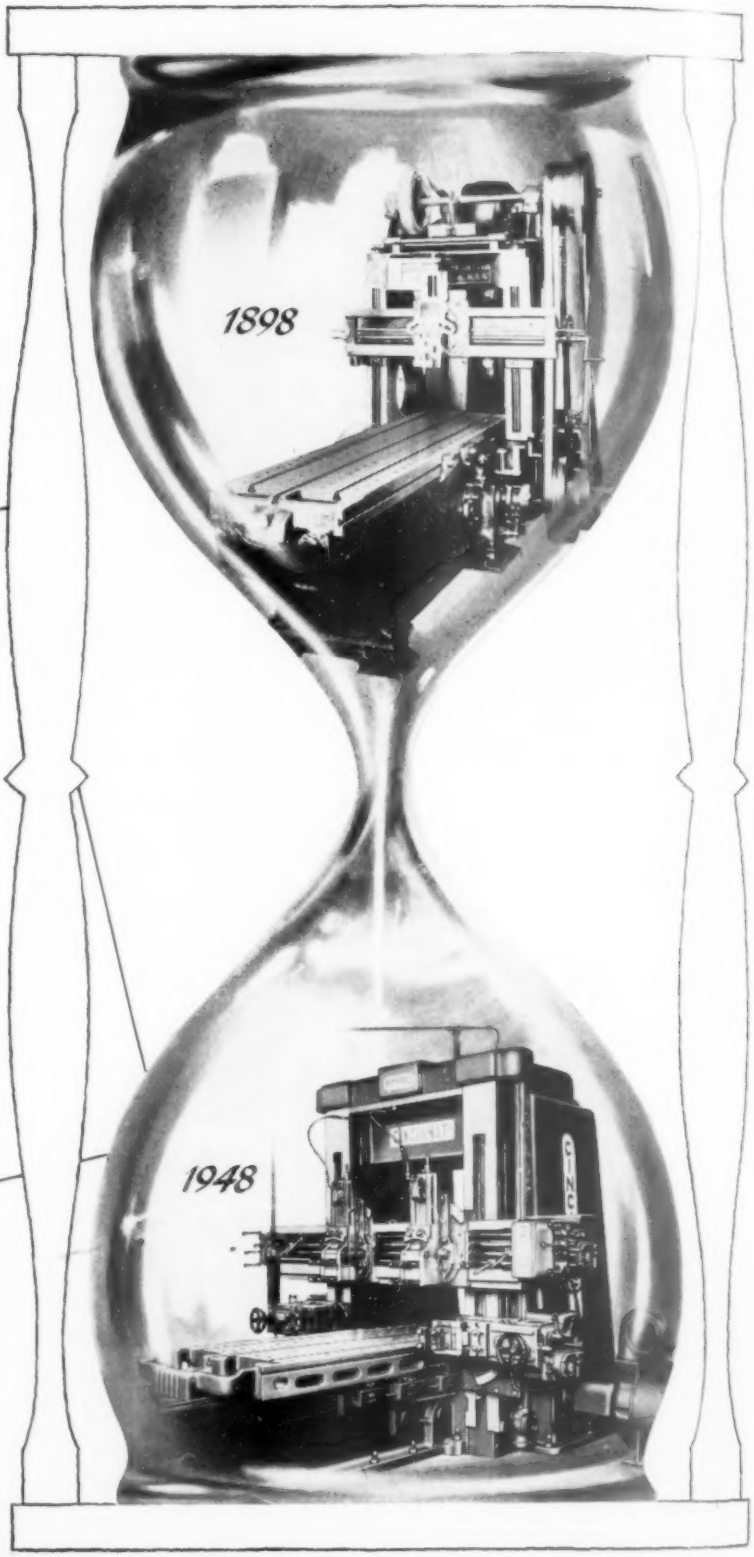
Gentlemen:

Please mail us your latest repair part list for your 30" x 30" x 8' metal planer. This planer has 101 stamped on cross rail.

Very truly yours,
WARREN AXE AND TOOL COMPANY

R. W. Koehler
Assistant Treasurer

RWK:rod cc



No. 101 was the first Planer manufactured by the Cincinnati Planer Company. They made a good Planer in 1898 of highest quality and finest workmanship which has stood the test of time.

Today we make an even better Planer. The modern Cincinnati HYPRO Planer, still retaining all of the Hypro-duction features and craftsmanship developed through years of experience, has been improved to incorporate new and exclusive features such as centralized finger-tip control for the complete operation of the machine, all steel hardened "twin" helical gear train, double nuts on both saddle and down slide screws, inverted dovetail slides, double acting tool block abutment, centralized dual saddle control and precision adjustment handles. These features provide increased production, lower planing costs and convenience to the operator.

Bulletin No. 138 will give you complete specifications. Write for it today.

THE CINCINNATI HYPRO PLANER COMPANY

PLANERS · BORING MILLS · PLANER TYPE MILLERS

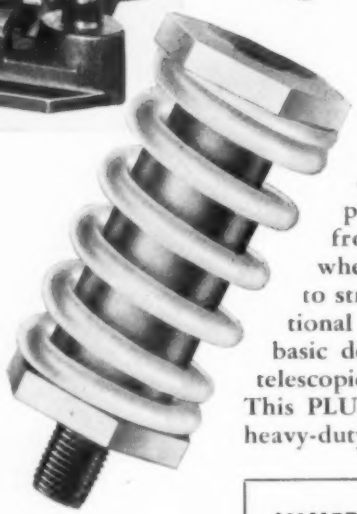
CINCINNATI, OHIO

Subsidiary of the Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.

NOTHING CAN BE
~~WITH~~ SIMPLER FOR
STRIPPING METAL FROM
CONVENTIONAL DIES THAN

WALES

NEW, IMPROVED
PATENTED STRIPPITS



● Showing a blanking die equipped with Wales-Strippits. Note how the Strippits are uniformly located around the die shoe to provide equal stripping pressure over the entire work area. The simplicity of this die construction and the minimum number of parts is made possible only with Strippits. Blanked work is shown at rear of die.

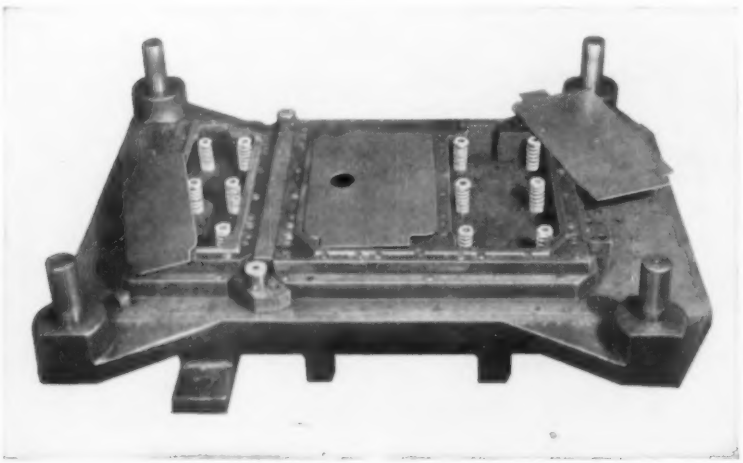
● Strippits are as easy to install as a bolt. May be replaced in a couple of minutes to change stripping pressure without removing the die from the press. Strippits are used wherever spring pressures are required to strip the work or scrap from conventional blanking and forming dies. The basic design feature is a retainer which is telescopic, non-revolving and self-contained. This PLUS new redesign provides for extra heavy-duty usage.

● Showing punched out blanks on top of die. Note the Strippits hold the center blank elevated above the cutting edge of the die for easy, quick removal of the work from the die. By using Strippits, without stripper plates, binding of blanks against the inside of the die cutting edge is eliminated.

IMMEDIATE DELIVERY FROM STOCK

By ordering a trial quantity of Strippits today, you can see the savings in your plant tomorrow. They do so much at so little cost as shown below.

Cat. No.	Wire Size	Length	Travel	O. D.	Initial Load in Lbs.	Price Each
2007	7/32″	2″	3/8″	1-5/16″	175	$3.20
2507	7/32″	2-1/2″	1/2″	1-5/16″	170	3.30
3007	7/32″	3″	3/4″	1-5/16″	140	3.40



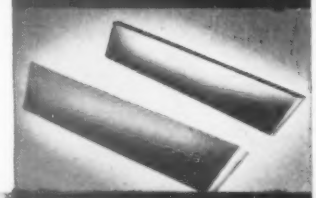
WITH WALES STRIPPITS no stripper plates are required...no springs to grind...no stripper bolts to make...no drilling and counterboring for stripper bolts...no boring of spring pockets...and no turning over of punch holder or die shoe after back sides have been planed...all machining is done from face side.

WALES-STRIPPIT CORPORATION
George F. Wales, President
393 Payne Avenue, North Tonawanda, N.Y.
(Between Buffalo and Niagara Falls)
WALES-STRIPPIT OF CANADA LTD.
Hamilton, Ontario
Specialists in Punching and Notching Equipment

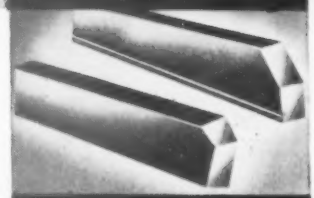
You can get these Special-Purpose tools *made of Abrasion-Resistant* HAYNES STELLITE Alloy

Trade-Mark

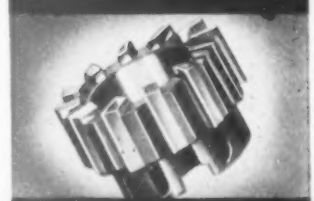
GROOVING TOOLS



CUTOFF TOOLS



BORING AND REAMING BLADES



SHELL END MILLS

COUNTERSINKS AND SPOT FACERS

FORM TOOLS

Besides a complete line of standard tool bits, tool tips, tipped tools, and milling cutter blades, HAYNES STELLITE alloy is also available in a large variety of special tools for many different purposes. The tools illustrated at the right are only a few examples of the many forms in which this well-known alloy is supplied. Many types of milling cutters, core drills, counterbores, and similar tools are also available —and all tools are made accurately to your specifications.

HAYNES STELLITE alloy—composed of cobalt, chromium, and tungsten—is a high-speed cutting metal for machining ferrous and non-ferrous materials. The alloy has proved particularly suitable for turning, facing, boring, grooving, milling, and forming. It is inherently hard. And since its hardness does not depend on heat-treatment, tools made of HAYNES STELLITE alloy retain their cutting ability even at red heat. This unusual combination of properties—and a good balance of edge-strength and toughness—makes possible heavy cuts at high speeds. This, in turn, means high production at low cost per piece machined.

If you would like complete information on styles, sizes, and prices of HAYNES STELLITE alloy tools, write for a copy of the booklet, "HAYNES STELLITE Metal-Cutting Tools." Our staff of experienced tool engineers will gladly give assistance on your machining problems, if you will contact our nearest district office.

HAYNES TRADE MARK *alloys*

Haynes Stellite Company

Unit of Union Carbide and Carbon Corporation

UCC

General Offices and Works, Kokomo, Indiana

Sales Offices: Chicago — Cleveland — Detroit — Houston — Los Angeles — New York — San Francisco — Tulsa

The registered trade-marks, "Haynes" and "Haynes Stellite" distinguish products of Haynes Stellite Company.

You can increase the capacity and production of your screw machines and turret lathes with R AND L TOOLS!

When you can add one more operation to your screw machines or turret lathes, you automatically increase production! Yet, with R and L Turning Tools, it is easy—and practical—to set up combinations of two or three operations! Just think what this would mean in your own shop! Undoubtedly, you have production problems right now which could be solved with R and L Turning Tools. Perhaps it is speeding up an intricate job by adding only one operation. There are so many ways in which R and L Turning Tools are proving their worth in shops throughout the country that we urge you to write us today for our illustrated booklet. This booklet shows a wide range of R and L applications. It provides you with many ideas which you can use profitably on your own turret lathes and screw machines.

R AND L TOOLS

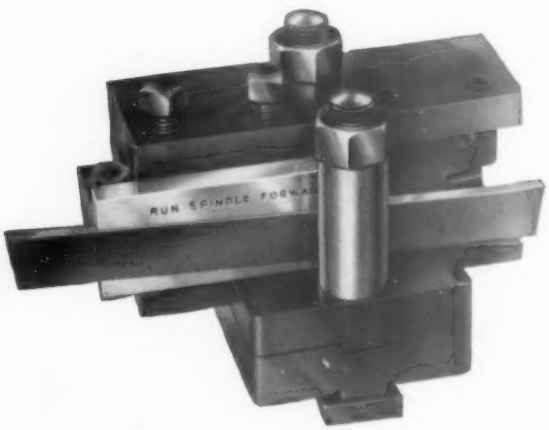
1825 BRISTOL STREET, NICETOWN, PHILADELPHIA 40, PA.

NEW R and L Tool Post

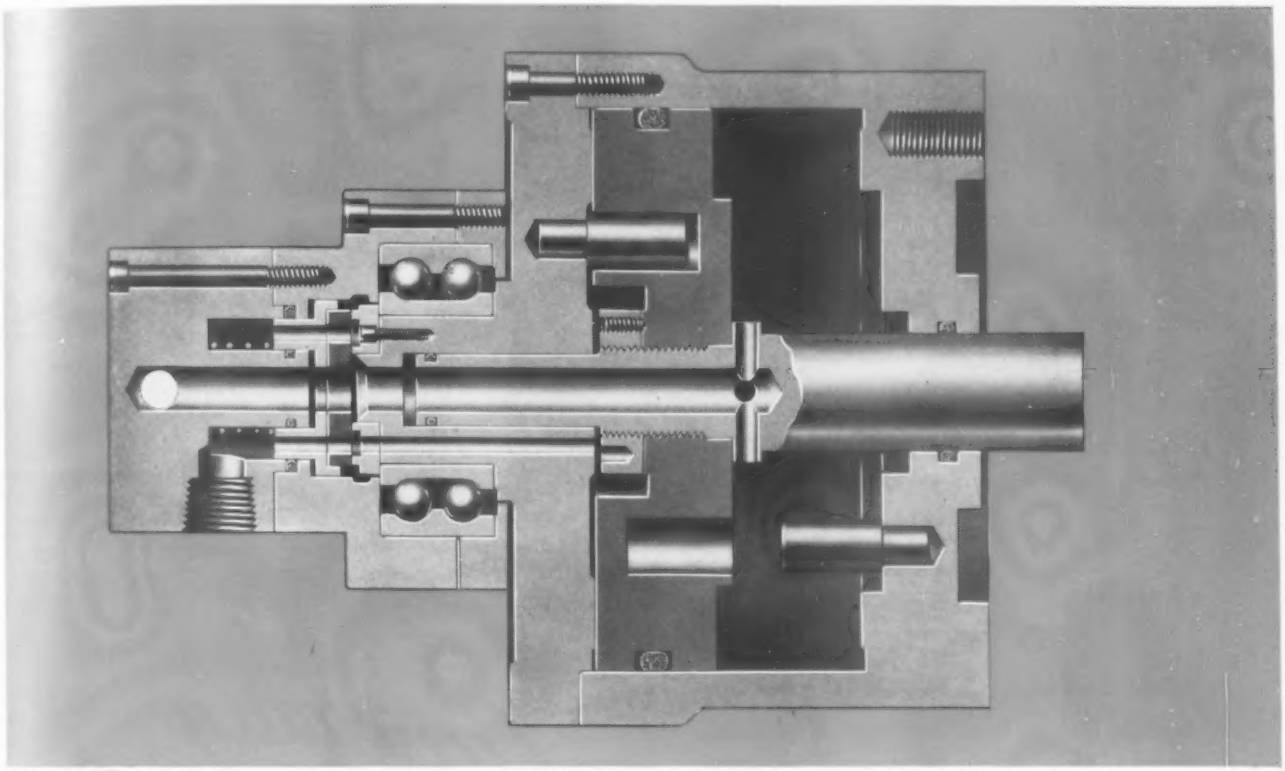
Holds all types of tools on front or rear cross-slide. Shown at left with the new R and L Cutting-Off Tool Holder.

NEW! R AND L Cutting-Off Tool Holders

Designed for use in our new R and L Tool Post shown at right and built in a variety of sizes and in two models for use on the front or rear cross-slide with the spindle running forward or backward. Another first by R and L to help you speed production!



NEW CUSHMAN HIGH SPEED AIR CYLINDERS



New positive pressure-balanced air seal and lock that reduces air leakage to a minimum.

Precision forged aluminum alloy construction with lapped bores. Light weight . . . low flywheel effect . . . long troublefree service.

Large air ports and low inertia result in much faster action . . . savings in time on short run operations.

Entire cylinder statically balanced *after* assembly for smooth operation at speeds up to 3500 r.p.m.

3¼" to 18" sizes. Write for further information.

a feature of **CUSHMAN POWER CHUCKING EQUIPMENT**

CUSHMAN also manufactures a complete series of WRENCH OPERATED CHUCKS
Write for Catalog 63 and Bulletins

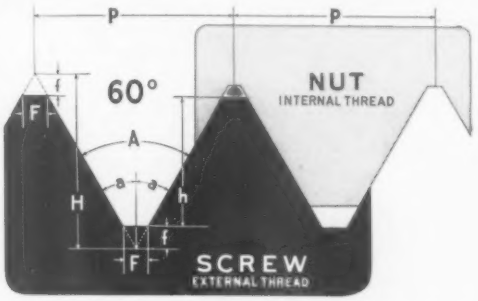
Send for Catalog PO-63 for information on Air Operated Power Chucks.

THE CUSHMAN CHUCK COMPANY
HARTFORD 2, CONN.

10CS48

The Science of Making MODERN SCREW THREADS

The basically simple idea of a screw thread has developed into a highly exact science in an age of machines that are held together by billions of threaded parts.

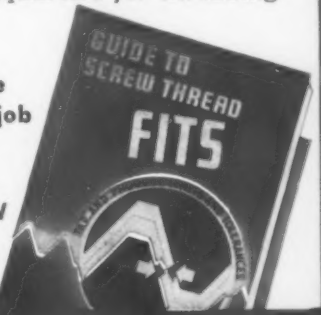


The sketch shows the basic design of the standard American screw thread. It cannot, however, begin to show the intricate problems which are involved in applying this and other thread forms to the varied uses of industry.

To make screw threads suitable for the exacting demands of mass production – modern industry requires three tools – a tap, a die, and a gage. The key word to describe the relationship of these three tools in terms of results is – "FITS". Working to tolerances of ten-thousands of an inch – the screw thread engineer must design and build the tools that will produce the RIGHT "fit" for the job.

Gages are an important member of the GTD "Greenfield" threading team that insures the right "fit" on the modern assembly line. It is only natural that the makers of precision taps and dies should also be qualified to make the gages needed to check them. *Today, when you think of taps and dies – think of gages, too. And when you think of all three – think of GTD "Greenfield", world's headquarters for threading tools.*

To help you get the right "fit" for YOUR job write for a free copy of "GUIDE TO SCREW THREAD FITS"



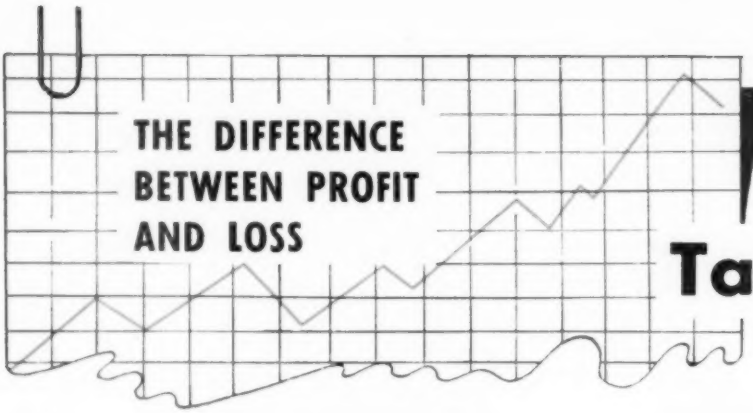
GTD GREENFIELD

World's Leading

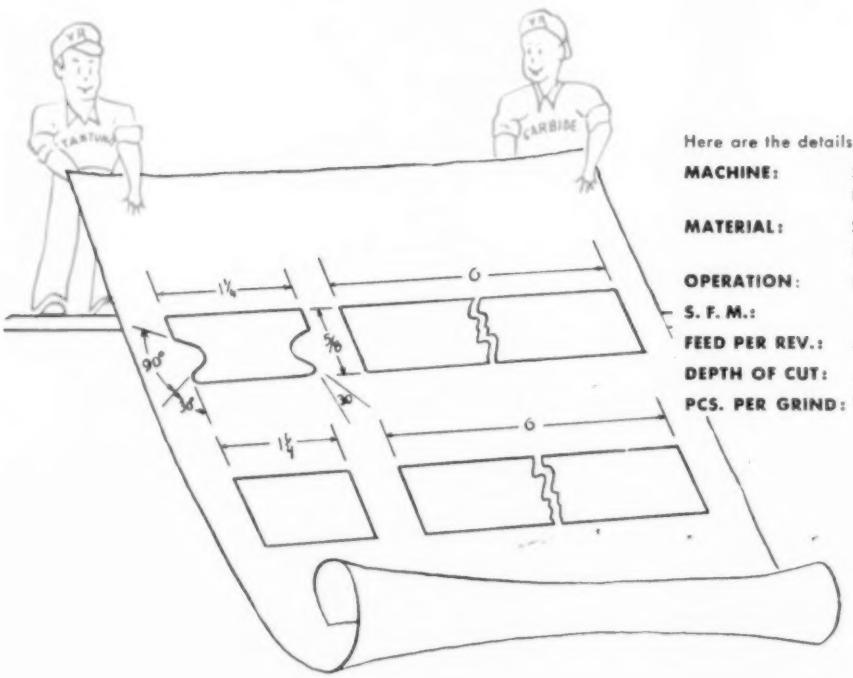
THREADING TOOLS

When you buy GTD "Greenfield", you get a quality of product that comes from the world's largest, most modern threading tool plant and its research staff of threading engineers – PLUS SERVICE from the leading distributors and GTD "Greenfield's" field men in every industrial center.

GREENFIELD TAP and DIE CORPORATION GREENFIELD, MASSACHUSETTS



Here is the case of a manufacturer faced with the problem of turning out 30 pieces per hour on a 30-year old vertical turret lathe . . . and the additional problem of keeping grinding room cost at a minimum. Using this old lathe equipped with high speed steel dovetail tools to face stainless steel bands, he was able to produce only 207 bands in 8 hours . . . and for each 8 hours spent in actual operating time, an additional 4 hours had to be spent in the grinding room sharpening worn tools. Realizing the costliness of this operation, the manufacturer turned to TANTUNG. Using solid preformed TANTUNG ⅝ x 1¼ x 6 dovetail tools on the same 30-year old vertical turret lathe his output for the next 8 hours was 336 pieces, before requiring regrinding.



Here are the details of the operation:

MACHINE:	36" 30-year old Vertical Turret Lathe
MATERIAL:	Stainless Steel Bands 17½" i. d. x 18" o. d. x 1" thick
OPERATION:	Facing Edges
S. F. M.:	195
FEED PER REV.:	.007
DEPTH OF CUT:	.187
PCS. PER GRIND:	TanTung — 420. High Speed Steel — 30

TANTUNG—tough, shock-resistant non-ferrous cast alloy, which can be cast to form requiring a minimum of grinding before use, performs at far greater speeds and feeds than high speed steels. To increase production without increasing cost . . . on your present equipment . . . ask your nearest V-R Field Engineer about **TANTUNG**. Call or write us today!

VASCOLOY-RAMET CORPORATION WAUKEGAN ILLINOIS

District Sales and Service in Principal Cities

An affiliate of The Fansteel Metallurgical Corporation and The Vanadium Alloys Steel Company

6-TON thrust loads and 1-TON radial loads can't budge tools gripped in UNIVERSAL COLLET CHUCKS

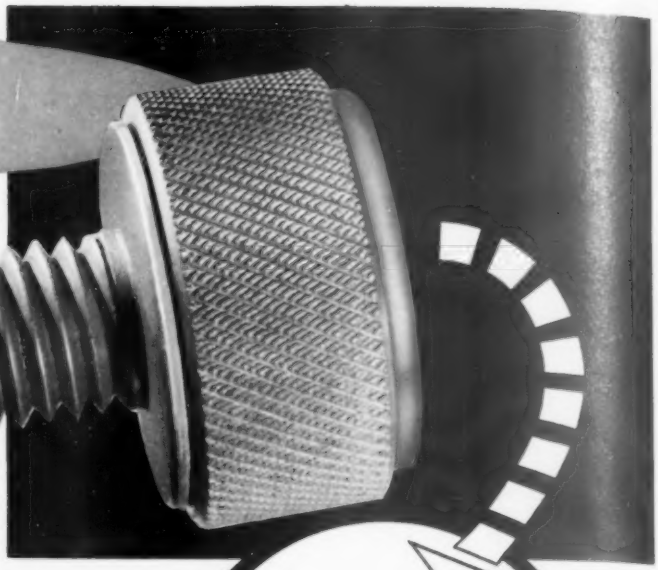
Universal Collet Chucks grip tools TIGHT! They hold end mills, taps, drills, and reamers positively rigid under 6-TON THRUST LOADS and 1-TON RADIAL LOADS. Special design produces *precisely equalized gripping power*—not at just a few points, but ON A CONTINUOUS SURFACE. That means you can use heavier feeds and greater speeds in your machining operations when you use Universal Collet Chucks—*you can turn out more work in less time.* Universal Collet Chucks grip tool flutes, permit stubbing, which eliminates cutting drills, thereby increasing profits. The Universal Collet Chuck is tightened so easily that LOCKING EFFORT IS REDUCED 50%. For faster, more accurate milling, drilling, reaming, and tapping in your plant, it will profit you to use Universal Collet Chucks. *Write for complete information.*

UNIVERSAL ENGINEERING COMPANY • FRANKENMUTH 3, MICHIGAN

YOU ASKED FOR IT...

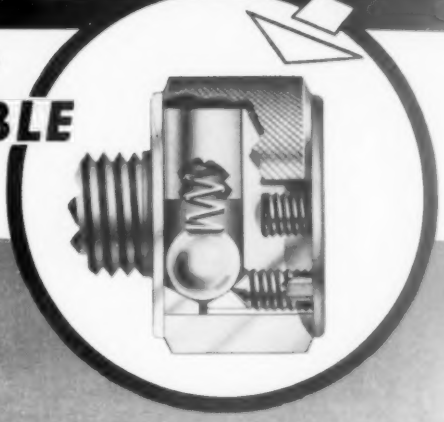
HERE IT IS!

VLIER



"SET YOUR OWN"

ADJUSTABLE



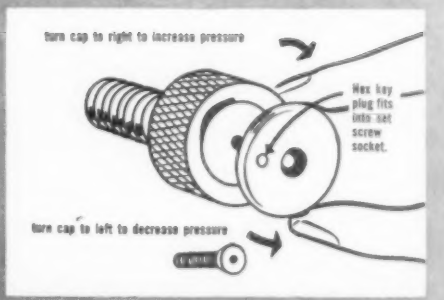
5 TO 50 POUNDS END PRESSURE...

TORQUE THUMB SCREW

In response to industry's demand for a Torque Thumb Screw that will not only hold during machining, but one which tool engineers can set themselves, to meet the requirements of many jobs, the Vlier *Adjustable* Torque Thumb Screw, with its wide range of 5 to 50 lbs. end pressure, presents the greatest boon to economical production ever offered. Setting the Vlier *Adjustable* Torque Thumb Screw is simple. Once set, the pressure will remain constant under all working conditions, assuring accurate holding tension, avoiding work distortion, preventing costly rejects and expensive fixture rework costs.

A trial will convince you the Vlier Adjustable Torque Thumb Screw is a "must" in your tooling operations.

Precision machined from properly hardened materials to give accurate life-time service.



Adjustment is made by simply removing center head screw, allowing rotation of adjuster-cap, which turns hex key, regulating pressure.

A few choice territories available for representatives as special distributors of the famous Vlier line.

Write today for detailed literature.

VLIER MEMBER

VLIER MANUFACTURING CO.

Manufacturers of Production and Tool Specialties

4552 Beverly Blvd., • Los Angeles 4, Calif.

CONTOURS - *Simple* OR *Intricate*

are Broached faster . . . for less

Increased production and uniformity of shape and tolerance are two of the most important advantages of contour broaching. Another is the surface finish of the part after broaching . . . usually suitable for final assembly.

In addition, there are great savings in tooling costs and maintenance. All but the simplest forms are broached progressively by a series of broach inserts, each of which produces a part of the contour. This progressive-type tooling eliminates the expense of costly tools having the complete form. Further, because each insert has but the simplest form, usually round or flat, the cost of tool sharpening is greatly reduced. In the event that one insert is damaged, only that section need be replaced. Idle machine time is cut, too, because simple design increases tool life.

Shown above are but a few broached contours of the hundreds for which Detroit Broach has designed and built the tooling. We will gladly outline the advantages of broaching the contours of your parts . . . and give you cost and production data for each. Call your local Detroit Broach representative or write today.

DETROIT *Broach* COMPANY

20201 SHERWOOD AVENUE
DETROIT 12, MICHIGAN

Available in Grades to suit your needs

Allegheny Ludlum High Speed Drill Rod in these specially-processed smaller sizes is available to you in all types of High Speed Steels, as well as high carbon-high chrome Die Steel types. You can get the *grade* you're used to, plus better results—why not investigate its possibilities?

ADDRESS DEPT. TE-69

Do you use High Speed Drill Rod in the smaller sizes? If so, here's an Allegheny Ludlum development that you can translate into real advantages—longer tool life, better performance, greater production.

A-L now *hot-draws* these small sizes by a special process, instead of cold-drawing with its repeated passes and anneals—each of which takes something out of the steel. The result is: a high degree of hardness, obtained with fine grain size, and with small, evenly distributed carbides for keen cutting edges; plus maximum toughness in the hardened and tempered condition.

By actual test, ⅛" *hot drawn* High Speed Drill Rod at 64 Rockwell C is as much as 18% *tougher* than cold drawn at the same hardness. ● But the best test is to *try* this Drill Rod—*prove* its merits for yourself. Check with your local Allegheny Ludlum Branch Office or distributor.

ALLEGHENY LUDLUM
STEEL CORPORATION
Pittsburgh, Pa.

TOOL STEEL DIVISION: DUNKIRK, N. Y.

Fine Tool Steels Since 1854

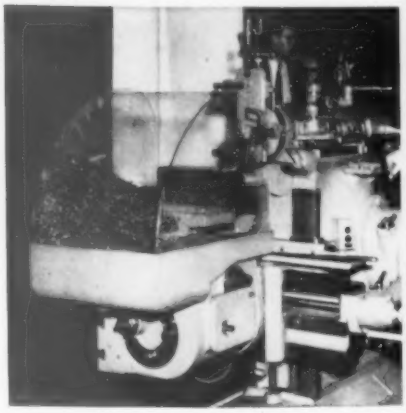
WAD 1778

Power down feed speeds vertical facing and slotting.

Supplementary table top for extra large clamping space

Auxiliary front cross feed is very helpful for developing contours.

The Cincinnati automatic tool lifter is essential for carbide tools and high speeds.



FAST SHAPING

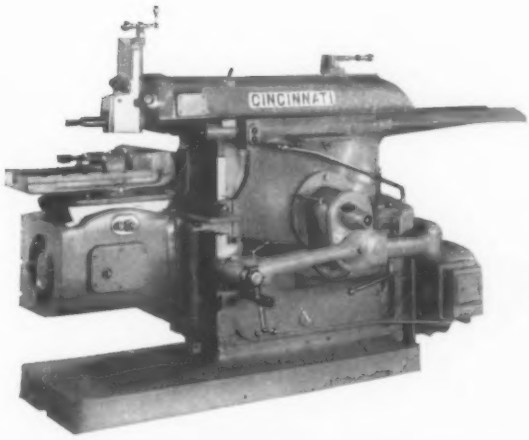
...and wide utility, too!

Powerful Cincinnati Shapers are tailored to your needs —the many features available to you will both speed your job and widen the use of a shaper in your shop.

Cincinnati Shapers are accurate, speedy and versatile. They are the handy man of industry.

Write for Catalog N3TE, describing the many features and many types of Cincinnati Shapers available to you.

Power elevation to the rail, with all controls convenient to the operator, reduces setup time.



A Cincinnati Shaper with universal table is especially useful for tool room and die work.

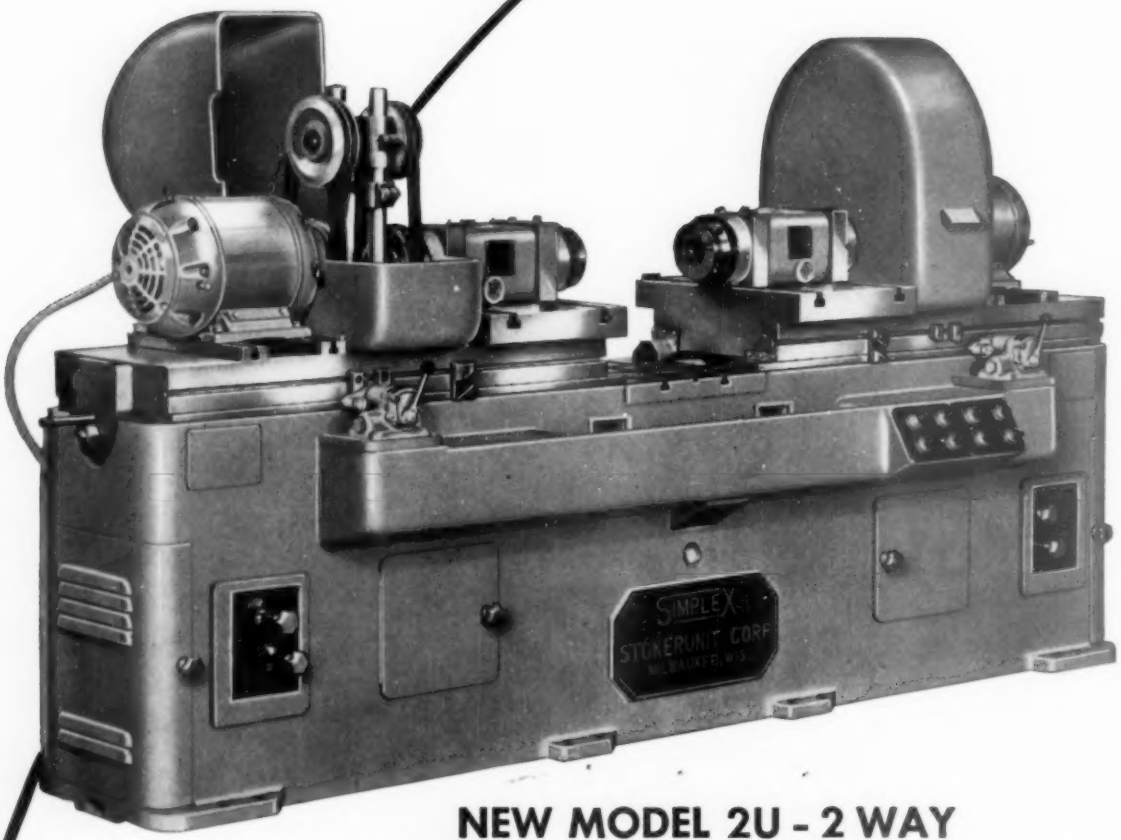
THE CINCINNATI SHAPER CO.

CINCINNATI 25, OHIO U.S.A.

SHAPERS · SHEARS · BRAKES

SIMPLEX

A New Concept of Precision Boring Machine Design



NEW MODEL 2U - 2 WAY

- NEW SEALED — LUBRICATION PRECISION BORING HEADS
- NEW ONE PIECE BED CONSTRUCTION
- NEW INCREASED CAPACITY PLATEN DESIGN

PRECISION BORING MACHINES

SIMPLEX MACHINE TOOLS DIVISION
STOKERUNIT CORPORATION
4528 West Mitchell Street
MILWAUKEE, WISCONSIN

Precision Boring Machines, Planer Type Milling Machines, Special Machine Tools

New Sole Supplier!

Johansson Gage Blocks

now made for all Western Hemisphere by Brown & Sharpe

With the recent purchase of the Johansson Division from Ford Motor Company, Brown & Sharpe now acquires all rights to manufacture and distribute Johansson Gage Blocks and Accessories throughout the Western Hemisphere.

Thus, industry is assured a continuing, dependable source of supply for Johansson products of the same unprecedented precision that has made them the world-wide measuring standard in mass production of interchangeable parts.

The Brown & Sharpe name is industry's guarantee that the traditional precision of Johansson Gage Blocks and Accessories will be maintained without compromise. This world-famous name has symbolized leadership in the development and manufacture of precision measuring devices, machines and tools for more than 100 years. Brown & Sharpe Mfg. Co., Providence 1, R. I.

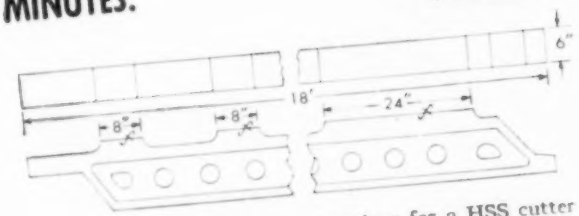
We urge buying through the Distributor

BROWN & SHARPE B·S

KENNAMILLING CUTS MACHINING TIME FROM HOURS TO MINUTES

ON STEEL

"UNIVERSAL" FACE KENNAMILL CUTS MACHINING TIME ON CAST STEEL BEAMS FROM 3 HOURS TO 24 MINUTES.



It took 3 hours and 2 separate operations for a HSS cutter and a carbide-tipped cutter to rough and finish mill four of these cast steel beams, having heavy sand inclusions. A "Universal" Face Kennamill removes the metal in one pass—gives superior finish—and reduces machining time 87%.

The "Universal" Face Kennamill is today's outstanding carbide cutter for milling steel. Its features include solid, advanceable Kennametal blades of tremendous strength and wear-resistance; a steel cutter body with precision-ground slots that support the Kennametal blades perfectly; and mechanical clamping that securely holds the blades with complete absence of strain.

ON CAST-IRON

AXIAL FACE KENNAMILL ROUGH AND FINISH MILLS IN ONE PASS. TURNS OUT 627 CYLINDER HEADS BEFORE REGRINDING.

This is typical performance by the Axial Face Kennamill—a total of 18,755 square inches milled on cast-iron cylinder heads before the blades required sharpening. Even then, the blades were in very good condition, and were reground only in order to maintain the high finish required on the manifold face of the piece.

The Axial Face Kennamill has solid blades of extremely abrasion-resistant Kennametal that give extended service without need for sharpening. It is designed for high rate milling with light or medium cuts on cast-iron. Grinding simplicity is one of its many cost-cutting features—it can be sharpened in a tool and cutter grinder, and usually only two surfaces on the blades need to be redressed.

KENNAMETAL

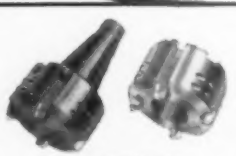
SUPERIOR CEMENTED CARBIDES

KENNAMETAL *Inc.*, LATROBE, PA.

There are standard Kennamills available for most face milling operations. See particulars in Catalog 48. Write for your copy.

HALF-SIDE KENNAMILL
(Solid blades)

"CF" KENNAMILL
(Solid blades)

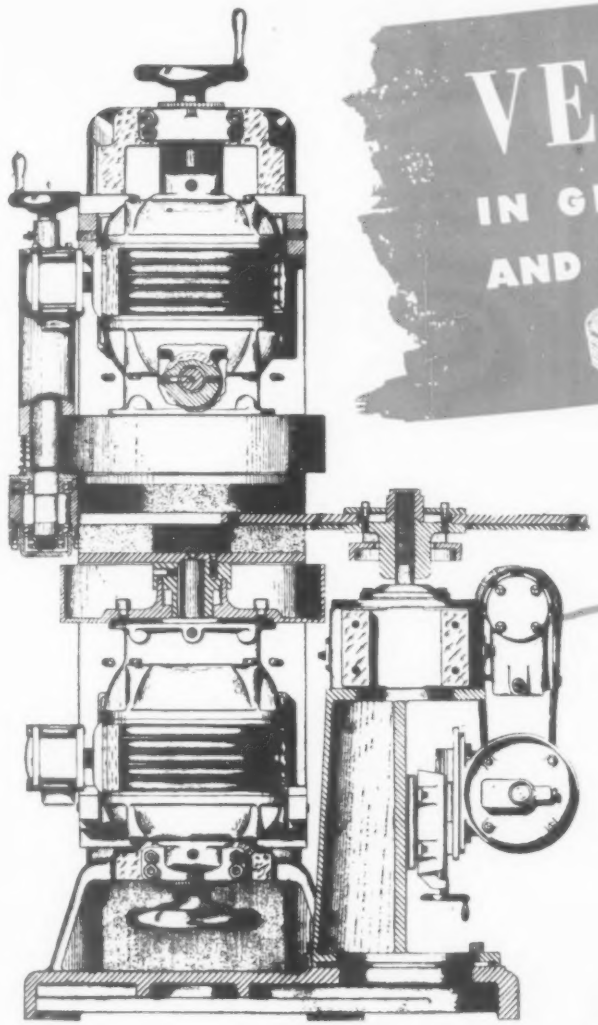


STEP KENNAMILLS
(Kennametal-tipped blades)

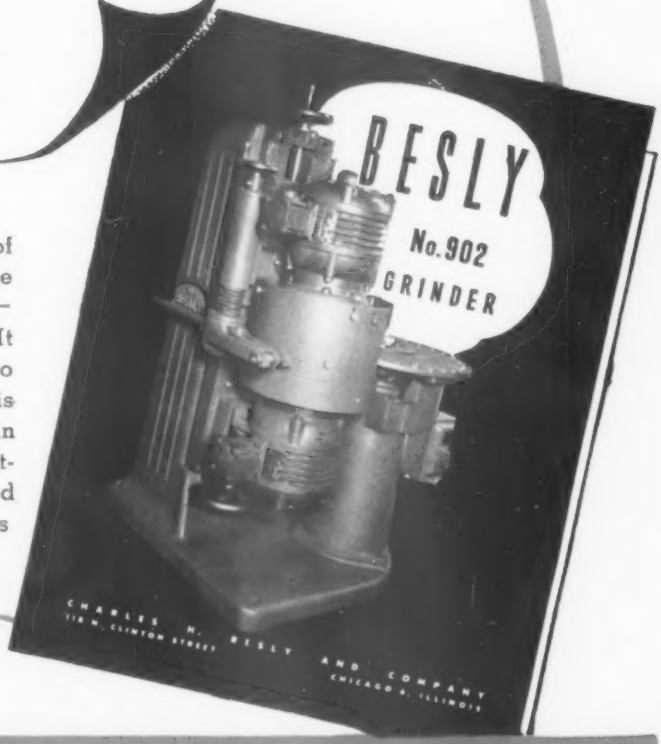
"ODD-JOB" FACE KENNAMILL
(Kennametal-tipped blades)

VERSATILE

IN GRINDING SPRINGS AND OTHER SMALL PARTS



BESLY GRINDERS



Designed originally for low-cost, precision grinding of small coil springs, this No. 902 Besly Vertical Spindle Grinder also handles a large variety of small parts—steel rollers, carbon brushes, ceramic parts, etc. It accommodates pieces from ⅛" to 1" O.D., from ¼" to 4" long. Though springs are usually ground "dry," this machine can be equipped for wet grinding. Speed in loading and unloading increases production rate. Output as high as 4,000 pieces an hour is readily achieved—depending on size, diameter and shape of parts

WRITE FOR THIS BULLETIN No. 902

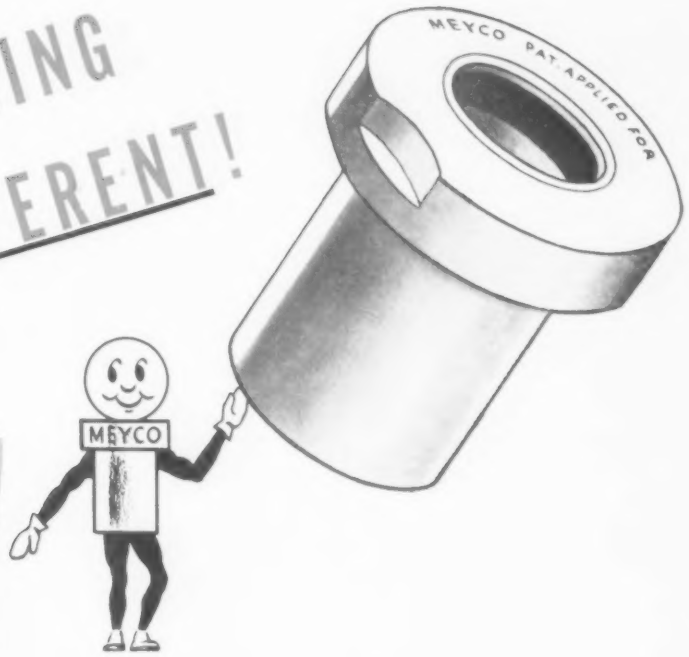
Ask for your copy today... It's free on request. This grinder may be the answer to your production needs. Why not talk it over with a Besly Engineer?

You'll Do BETTER with **BESLY**

BESLY GRINDERS AND ACCESSORIES
BESLY TAPS • BESLY TITAN ABRASIVE WHEELS

CHARLES H. BESLY & COMPANY • 118-124 North Clinton Street, Chicago 6, Illinois
Factory: Beloit, Wisconsin

A DRILL JIG BUSHING —THAT'S DIFFERENT!



MEYCO Carbide-Inserted Drill Jig Bushings Cost a Little More, But Last Much L-o-o-onger!

● Will these bushings save you money? Will they cut production costs? Figure it out yourself: Actual field tests have shown that Meyco bushings with the carbide inserts outlast cast alloy, high speed steel and standard carbon steel bushings by 10 to 50 times . . . yet their cost is approximately 6 to 10 times that of ordinary bushings.

But that's not all the savings! Meyco Carbide-Inserted Drill Jig Bushings will increase the life of drill jigs and fixtures, reduce non-productive machine time and non-productive man-hours, save on spoilage, save on inspection time and increase drill and reamer life.

And finally, no change is necessary in drafting room or tool design. Made to ASA standards, you can start using them right away.

For details, further information and price schedule, write today for Meyco Bushing Catalog No.13.

W. F. MEYERS CO., INC., BEDFORD, INDIANA

38% Longer Running Time Between Grinds

Actual test in customer's plant proves that CLE-FORGE HIGH SPEED DRILLS produce *more holes per grind*

A series of impartial tests on four makes of drills proved that CLE-FORGE High Speed Drills averaged 9 hours between grinds; the next best record was 6½ hours. You too can get greater production, less "down time" and lower costs by using CLE-FORGE High Speed Drills. Engineered into every one of them is the *stamina* that produces more holes per grind. Whenever you have a drilling problem, get in touch with a CLEVELAND Service Representative through our nearest Stockroom —or **Telephone Your Industrial Supply Distributor.**

CLEVELAND

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THE CLEVELAND TWIST DRILL CO.
1242 East 49th Street Cleveland 14, Ohio
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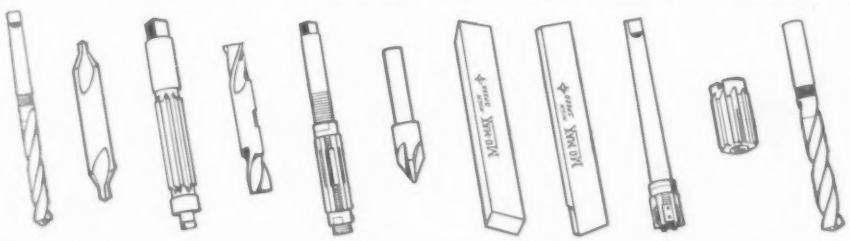
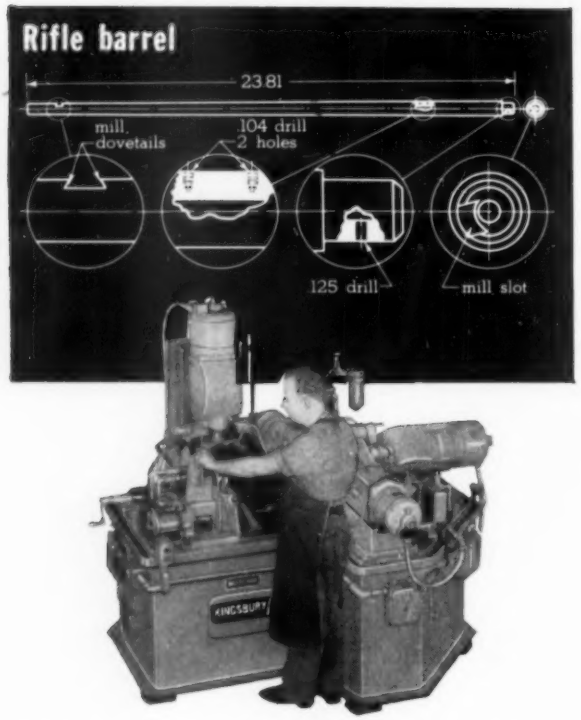
ASK YOUR INDUSTRIAL SUPPLY DISTRIBUTOR FOR THESE AND OTHER CLEVELAND TOOLS

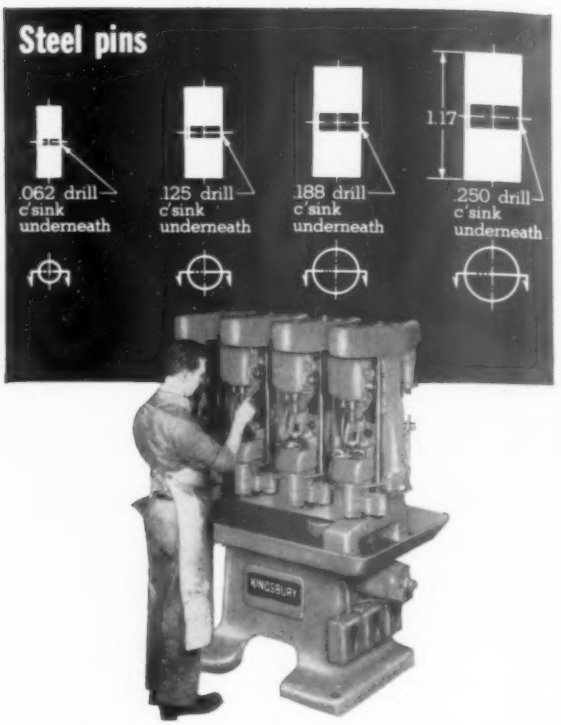


"CLEVELAND" DISTRIBUTORS EVERYWHERE
are ready to serve you!

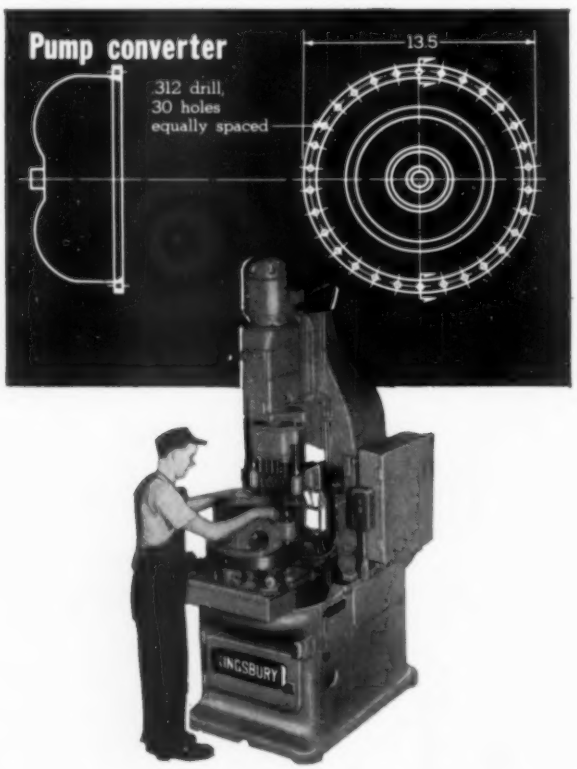
Solving High Production Problems



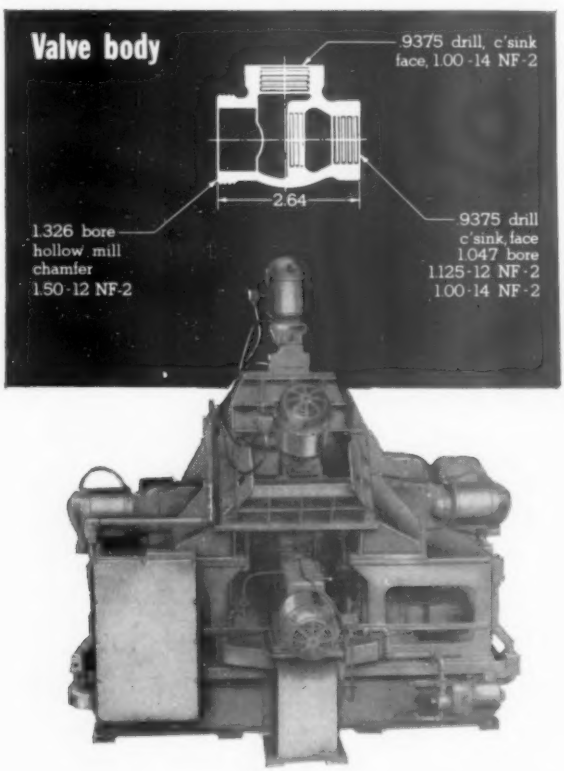
A MULTI-WAY NON-INDEX MACHINE has 4 units that mill and drill from 4 directions in 32 seconds. An air cylinder moves clamps that grip the part against vees with no distortion.



A CROSS DRILL AND COUNTERSINK MACHINE has 4 vertical drilling units and underneath burring attachments that complete 1100 pins an hour. The fixtures hold pins of different sizes.

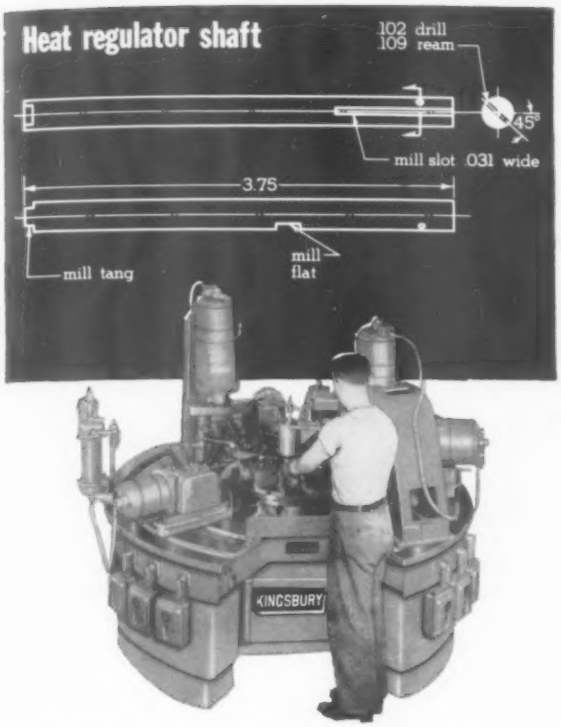


AN INDEXING FIXTURE rotates each part on its own axis 60° each index. The drilling unit has a 5-spindle auxiliary head. Bushings guide the drills. Rate is 100 parts an hour.

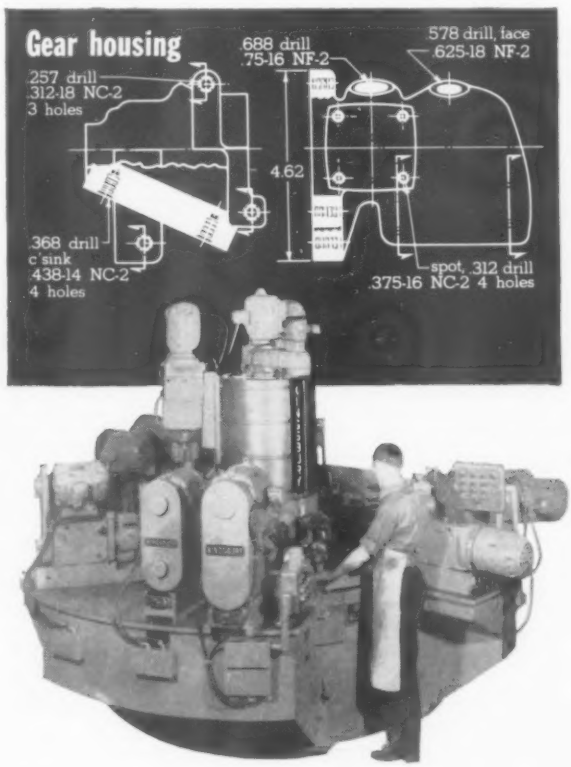


A VERTICAL INDEXING MACHINE enables 4 horizontal units to work on each end of the valve. The rear view shows the 3 radial units for the outlet face. Rate is 500 parts an hour.

. . . . . 6 Ways



A HORIZONTAL INDEXING MACHINE drills, reams and mills 370 shafts an hour gross. Each part is chucked in 1 of 6 identical fixtures and indexed to each automatic unit in turn.



AN INDEXING MACHINE WITH CENTRAL COLUMN operates 35 spindles on 4 faces of part in 1 chucking. When the table indexes, 12 chucks each rotate 90° Rate is 340 parts an hour.

Operators' pay and initial cost of these 6 machines together average 1/7 cent per operation

If every machine shown here were used only 3 years and the operators received good wages, the average cost for man and machine together would be $0.0014 per operation. (One tool in one hole counts as one operation.) We divided the total investment over 6000 hours, assumed 80% efficiency and omitted power and overhead costs.

Additional Savings

Less handling, extra space. One Kingsbury replaces several general purpose machines.

Uniform product. Automatic cycles never vary. Fixtures that index are identical duplicates.

Accurate location of operations. Bushings guide drills and reamers. All operations are finished without disturbing the work in its fixture.

Smooth finish, efficient operation. Spindles for different operations are independent and run at the exact speed and exact feed required.

Accurate, Rugged Construction

Most Kingsburys must pay for themselves in months, but they will do accurate work for years at intense production. We normalize castings before machining, and induction-harden and shave gears. Spindles run in preloaded precision bearings. Eleven accurate jig borers bore index tables, fixtures and bushing plates. We never release any machine until it produces sample parts that meet the customer's specifications.

Efficient Use of Standard Equipment

In the Kingsbury line are 12 standard automatic drilling and tapping units (max. 5 hp) with a total of 82 standard attachments, 8 standard indexing units and 18 standard bases. There are 6 basic types of machines as these photos show. Our top men study and discuss ways to combine operations using this equipment until they agree on the most economical solution. We have designed, built and tooled over 3400 automatic drilling and tapping machines. It is our exclusive business.

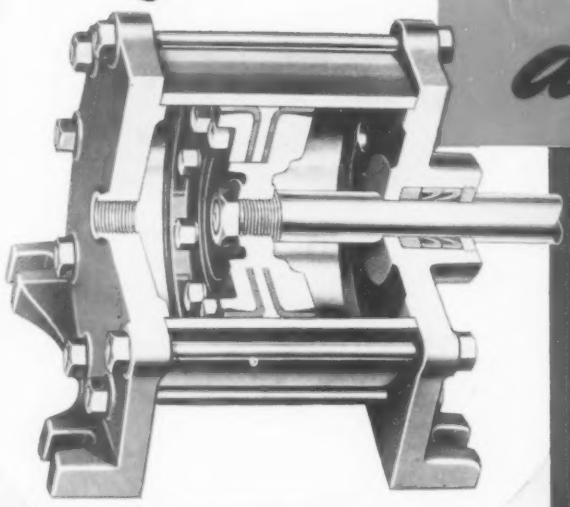
We Can Design, Build and Tool Your Machine

Ask our Mr. L. A. Carll for a proposal, and then compare your savings. Send him a print of a high production part and tell him the operations and hourly production you need. Or ask him for free bulletins that show 40 other setups. Kingsbury Machine Tool Corp., 50 Laurel St., Keene, N. H.

KINGSBURY

Replace Inefficient Hand and Mechanical Operations...

Get FAST-ACTING, POSITIVE, CONTROLLED POWER at Low Cost...



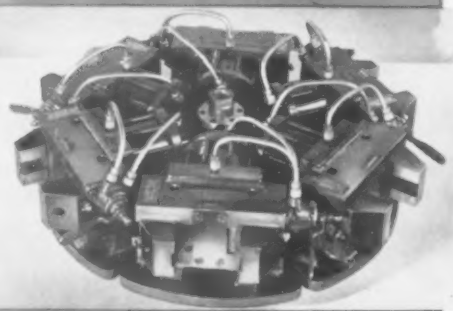
with **Logan** NON-ROTATING

AIR CYLINDERS

FOR • PUSHING • PULLING • LIFTING HOLDING and OTHER APPLICATIONS

These Logan Features Assure Peak Performance and Long Life

- Quicker response obtained through larger ports.
- Higher pressures permitted by more sturdy construction; heavy duty nickel-chrome iron covers. Bronze bushing supports and aligns piston rod.
- Cylinders can be furnished with cushioning at one or both ends to eliminate shock at end of stroke.
- Maximum power without leakage assured by molded composition packing cups, self-adjusted by air.
- Permanent seal around rod provided by sea ring packing, self-adjusted by air.



To get fast-acting, convenient power for pushing, pulling, lifting and holding operations, replace inefficient hand actuation with *standard* LOGAN Air Cylinders. Many profitable advantages can be obtained that will increase production in industrial applications of all kinds.

The constant power with follow-up assures positive, uniform actuation. Control valves may be located at any convenient point, adjacent or remote. Important savings in operator time and fatigue will result. In addition, the use of LOGAN Air Cylinders often permits simplifying the design of a mechanical structure and reducing amount of floor space required.

LOGAN Air Cylinders are available in 7 types of mounting to fit almost every requirement; interchangeable end covers permit a wide range of combination mountings. Manufactured in sizes from 1½" to 24" bore, with any length of stroke up to 18 feet. Recommended for operation at pressures up to 150 p.s.i.

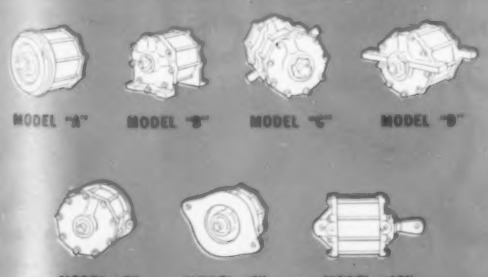
ENGINEERING ADVICE . . .

Write for recommendations on the proper cylinders for your applications and most effective methods of installation. No obligation.

USE COMPLETE LOGAN AIR EQUIPMENT . . .

For highest efficiency, use Logan equipment throughout in your complete air installations. Logan cylinders, control valves and air accessories are designed to work together as a balanced air system.

LOGAN AIR CYLINDERS ARE AVAILABLE IN 7 STANDARD MOUNTING TYPES



Logan

SAVES ★TIME ★EFFORT ★MOTION

Air and Hydraulic Equipment

LOGANSPORT MACHINE CO., INC.

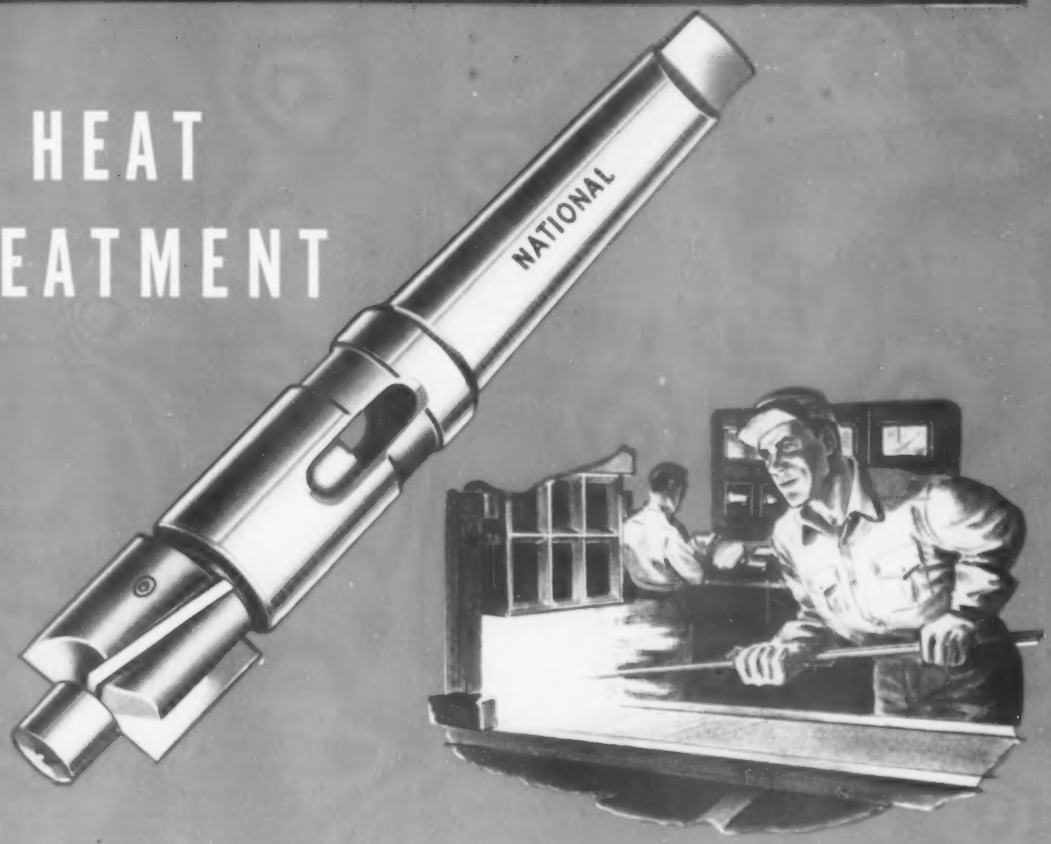
931 CENTER AVE. LOGANSPORT INDIANA

CHUCKS • CYLINDERS • VALVES • PRESSES • SURE-FLOW COOLANT PUMPS

Write for FREE literature on Logan air valves, cylinders and accessories.

PERFORMANCE IS BUILT INTO NATIONAL METAL CUTTING TOOLS

HEAT TREATMENT



National Counterbores are noted for their rugged construction, simplicity of design, and adaptability to a wide variety of operations. The complete National line also includes Twist Drills, Reamers, Milling Cutters, End Mills, and Hobs.

● Scientifically exact heat treatment is an important factor that assures you better performance from National metal cutting tools. At the new National plant, this critical step in quality tool manufacturing is closely controlled and safeguarded by the use of the best equipment obtainable. This applies to furnaces as well as to time and temperature controls. No important operation relies on the human element.

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LEADING DISTRIBUTORS EVERYWHERE offer complete stocks of NATIONAL Cutting Tools. Call them for cutting tools or any other staple industrial product.

NATIONAL TWIST DRILL AND TOOL COMPANY

ROCHESTER, MICHIGAN, U. S. A. Tap and Die Division—Winter Bros. Co.

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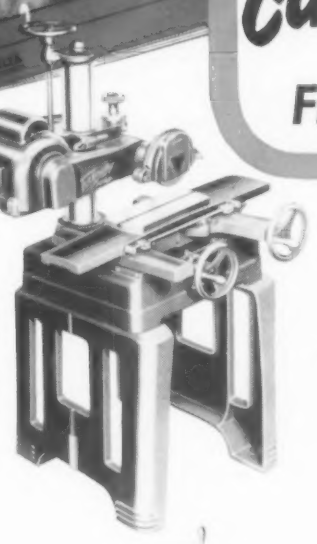
5 Delta-Milwaukee® machines that cut grinding costs in your toolroom or production shop

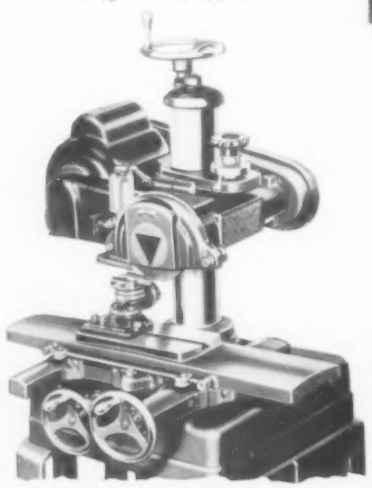
Free bulletin tells how!

DELTA
MILWAUKEE
®

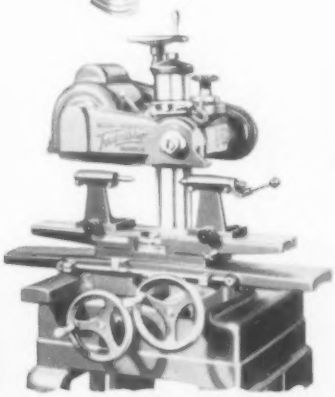


Delta Toolmaker* Surface Grinder —For the tool room or production shop. Has wide graduations on micrometer, for close settings. Unique wheel-adapter saves time on truing-up operations. Many other features. 7" x ½" wheel, 1¼" bore.

Delta Grinder with Twin-Lite* Safety Shields — Twin-Lite Safety Shields act as "built-in goggles," flooding the work with light. Fully-machined tool rests. Balanced wheels. Lubricated-for-life ball bearings.



Delta Toolmaker* Chip-Breaker Grinder — For grinding the chip-breaker groove in carbide-tipped tools. Also for grinding form tools, thread chasers, etc. Holds the tool at any conceivable angle. Quickly and accurately reset.



Delta Toolmaker* Tool and Cutter Grinder —Grinds at almost any angle. Table swivels full 90°. Centers have maximum spacing of 16¼". Table surface, 5¾" x 13". Delta construction features assure perfect alignment and freedom from play.

Delta Carbide Tool Grinder — Combined with Delta's standard tool grinder for hogging down the shank steel, this machine gives you a perfect working combination for sharpening tungsten carbide tools.

*Trade Mark Reg. U. S. Pat. Off.

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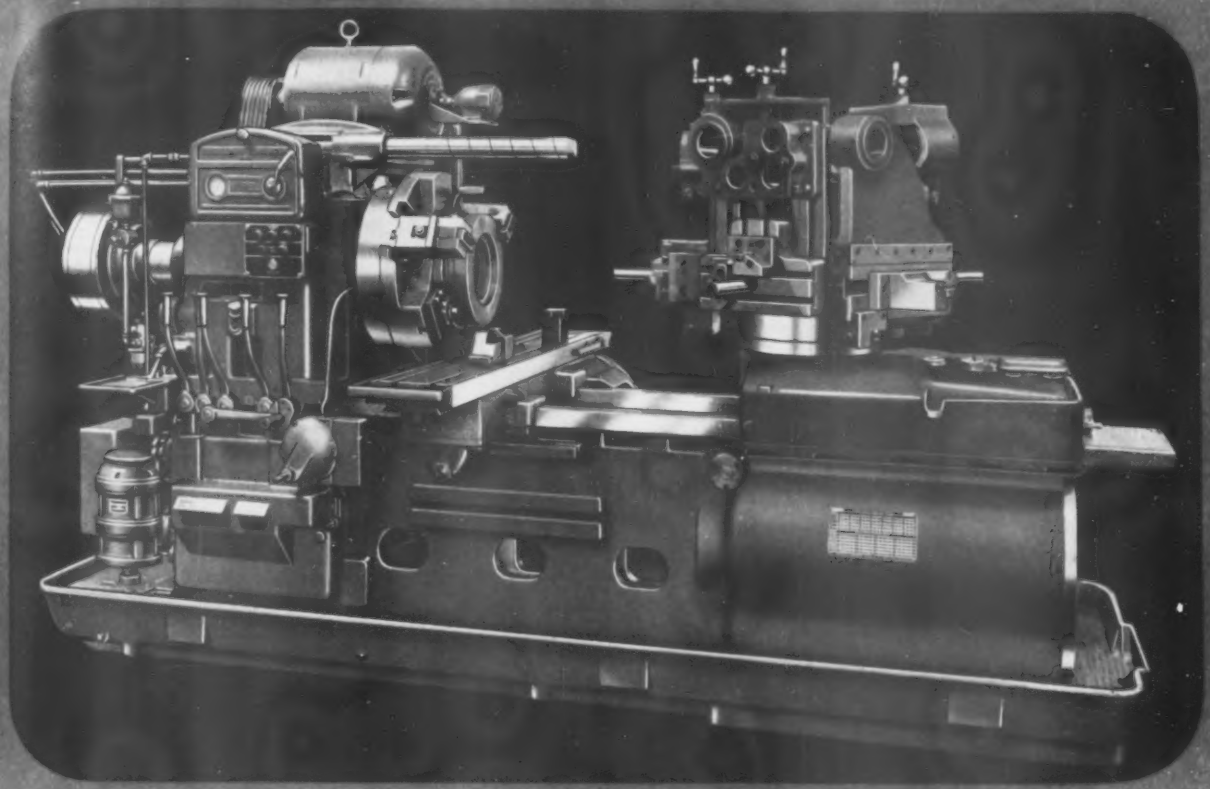
gher productive capacity and greater flexibility: P.&J.'s

6-DRE *automatic turret lathe*



SPECIFICATIONS

	6DRE	6DREL	6DRELX
BED swing over	34"	34"	34"
CROSS SLIDE swing over	21"	21"	21"
travel each way	8 1/2"	8 1/2"	6 1/4"
TURRET no. of faces	5	5	6
slide travel	16"	25"	28"

Our engineering department is ready to assist you at any time in developing improved methods of handling your work.

Unit construction throughout gives the 6-DRE unusual power and rigidity. To these qualities add four automatic changes of spindle speed, three selective automatic changes of feed, automatic binding of the turret following index, direct cross slide action and a motor driven constant rapid traverse motion to the cross slide and turret slide. The result is a machine that produces MORE of BETTER QUALITY WORK at LOWER COSTS. The Potter and Johnston Co., subsidiary of Pratt and Whitney, could rest its case right here—but here are more special features marking the 6-DRE AUTOMATIC TURRET LATHE. There are 20 changes of speed between 9 and 167 rpm. A special high speed model is available with a maximum spindle speed of 304 rpm. These speeds are arranged in five sets of four automatic changes. Any group of four changes is quickly obtained by application of proper set of hand pick-off gears. An automatic type spindle stop is provided, allowing the cutting tools to return to neutral position without scoring the work. 24 feeds are arranged in three groups: coarse, medium and fine. Complete details furnished on request.

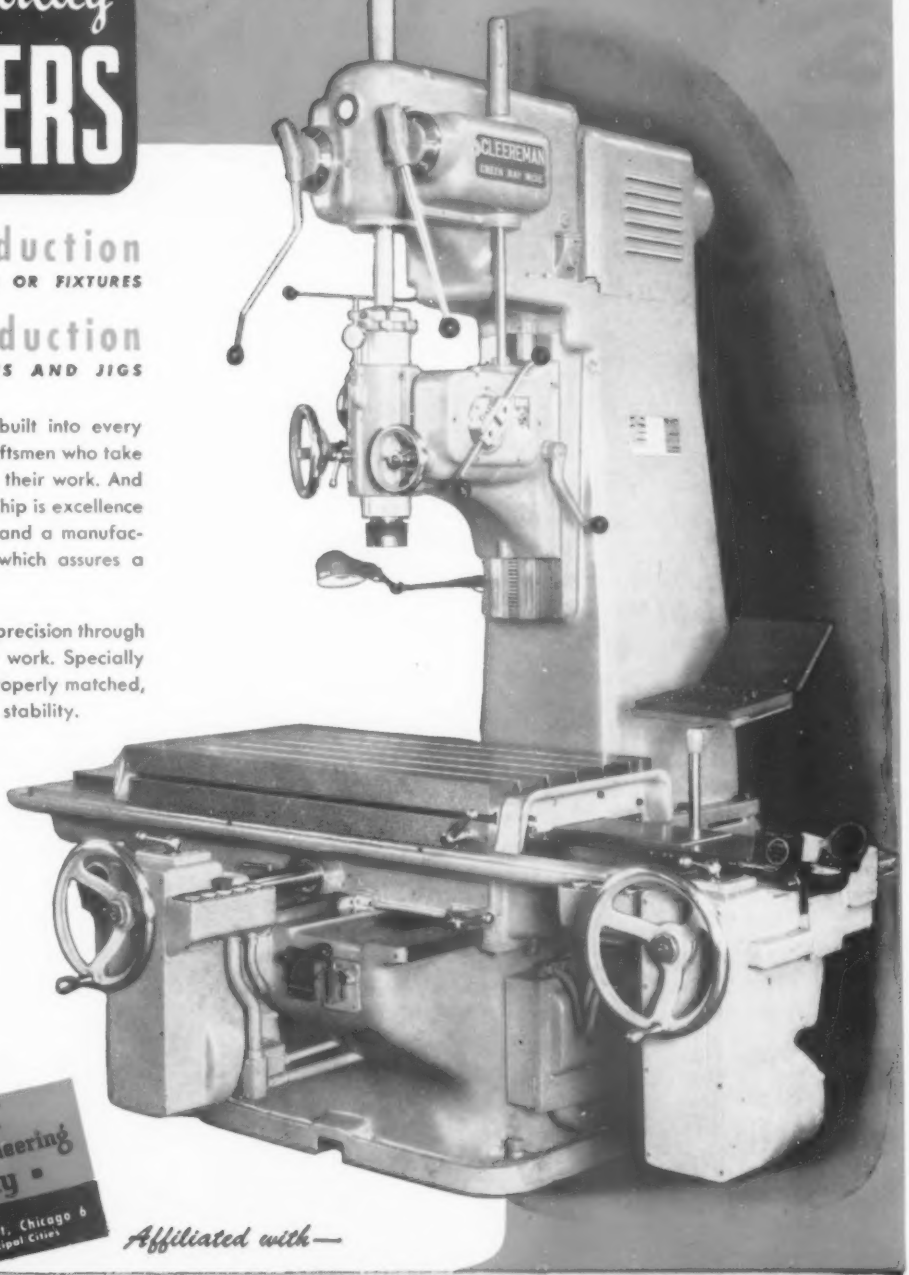
POTTER & JOHNSTON CO.
PAWTUCKET, RHODE ISLAND
Subsidiary of
PRATT & WHITNEY
Division Niles-Bement-Pond Company

CLEEREMAN

UNEXCELLED PRECISION

PRECISION with STAMINA and *Operating Facility*

JIG BORERS



Small Lot Production

WITHOUT LAYOUT TIME, JIGS OR FIXTURES

Tool Room Production

OF ACCURATE TOOLS, DIES AND JIGS

UNEXCELLED PRECISION is built into every Cleereman Jig Borer by skilled craftsmen who take a personal pride in the quality of their work. And behind their exceptional workmanship is excellence of design, exacting specifications and a manufacturing technique and procedure which assures a precise machine tool.

STAMINA maintains this in-built precision through a long life of extremely accurate work. Specially processed and tested materials, properly matched, combat wear of ways and secure stability.

OPERATING FACILITY has long been accepted as characteristic of all Cleereman machine tools. Convenient, time saving grouping of controls aids appreciably in producing more work. Prepositioning power rapid traverse or electronic traverse and milling control accessories speed operation.

WIRE OR WRITE for catalog with complete specifications.

Address —

1908 - 1948 40th Anniversary CLEEREMAN MACHINE TOOL CO.

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CLEEREMAN MACHINE TOOL CO. Green Bay, Wis.

BUILDERS OF PRECISION JIG BORERS AND DRILLING MACHINES

NEW BENCHMASTER

DEEP THROAT 4 TON punch press

● Here's the press you need for punching large sheet steel and other stock in a jiffy. Its deep throat gives extra capacity—now enables punching to the center of a 17½" circle! Extra sturdy frame is heavily reinforced at all stress points. Press weighs 340 lbs.!

The new Benchmaster retains all the quality, engineering advantages and proven performance features of the standard model—yet gives you CAPACITY seldom encountered in larger presses! Available as a bench model or with legs as a standard extra. *Write for bulletin giving complete details.*

benchmaster MANUFACTURING COMPANY
5532 WEST PICO BOULEVARD
LOS ANGELES 4, CALIFORNIA
WORLD'S LARGEST PRODUCER OF SMALL PUNCH PRESSES

These
"EDUCATED DIAMONDS"
can't come loose!

How would you like a dresser that really *holds* its diamonds?

Here's one that will do it—thanks to its matrix of Carboloy Cemented Carbide.

What's more, this special carbide matrix makes it possible to use small, inexpensive diamonds—and you get the savings.

Are you interested in savings of up to 40% in your dressing costs? Let us send you our free brochure, "The More Profitable Use of Diamonds for Dressing Grinding Wheels." Ask for brochure No. DR-480. *Carboloy Company, 11101 E. 8 Mile Street, Detroit 32, Mich.*

DIAMOND DRESSERS
by CARBOLOY®

INCREASED PRODUCTION ★ BETTER WORK
with
Boyar-Schultz Screw Machine Tools

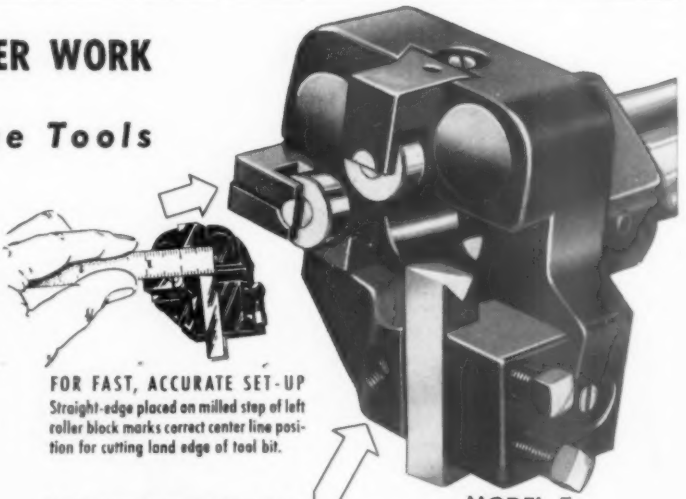
A Turning Tool with outstanding features that increase quality production and reduce down time and rejections to a minimum.

Precision made from the finest steels, it is designed for very close tolerance work and made with the built-in strength to hold adjustments accurately through long runs.

An extremely easy tool to set up and adjust. After regrinding, the tool bit can be returned to holder in the same exact position with minimum lost time. The result—less down time.

Available in 6 sizes, 000 to 3.

WRITE FOR NEW SCREW MACHINE TOOL CATALOG.

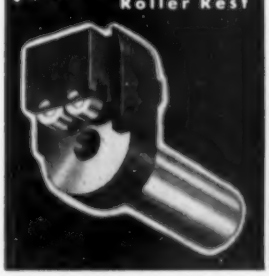


FOR FAST, ACCURATE SET-UP
Straight-edge placed on milled step of left roller block marks correct center line position for cutting land edge of tool bit.

Tool steel can be removed from tool bit holder, sharpened and returned to holder in the correct position with a minimum of down time

MODEL T TURNING TOOL

NEW! MODEL RR Roller Rest

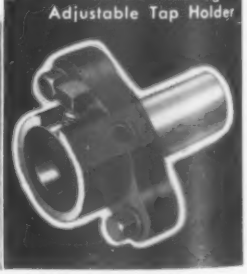


Model K Knurling Tool
In Three Sizes, 00, 0 & 2

Model DRH Adjustable Drill and Reamer Holder
In Three Sizes

Model C Burnishing Tool
Made In Three Sizes
00, 0 & 2

NEW! MODEL AT Non-Releasing Adjustable Tap Holder



BOYAR-SCHULTZ CORPORATION **2104 WALNUT ST., CHICAGO 12**

BROACHING CUTS COSTS FASTER!

PIONEERS OF H.S.S. BROACHING

COLONIAL

BROACH CO. DETROIT 13

BEST BY TEST

Colonial broaches represent the fastest, surest, precision method there is for removing metal. May be used equally effectively for all kinds of internal or external shapes, regular or irregular.

Wherever they CAN be used, they are bound to give you greater output per machine hour—and that means REAL SAVINGS—savings that pay for the tooling cost in a surprisingly short time.

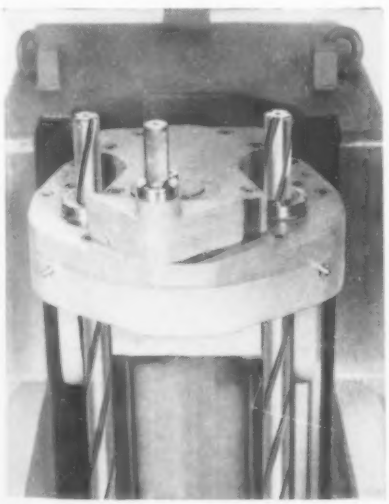
There's a Colonial field representative near you. Ask us to have him figure where and how much *you* can save; how much you can boost your output per machine hour.

STEEL — BRONZE — COPPER

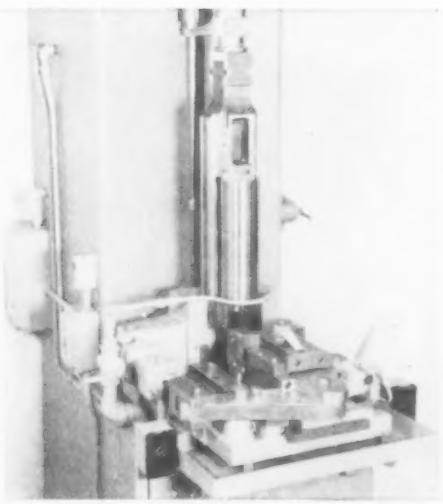
Internal Gears and Splines

Telephone Relay Parts

Electrical Breaker Arms

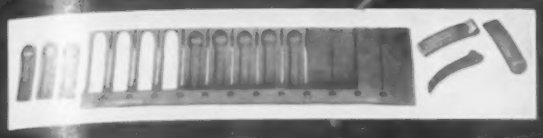


One pass of the broach and the internal gear or spline is finish-cut. Accuracy is insured by Colonial's specially developed involute and other broach checkers and grinding methods.



It is impossible by any other method to maintain the accuracy of the cam teeth on parts like these while getting the production obtained with Colonial Broaches (360 per hour at 85% efficiency).

800 to 1000 pieces per hour on one machine with the two sets of Colonial broaches shown here (one set also 'disassembled' to show simplicity). Parts are broached 8 at a time.



120 Pieces Per Minute ...from 3½" x .018" Brass

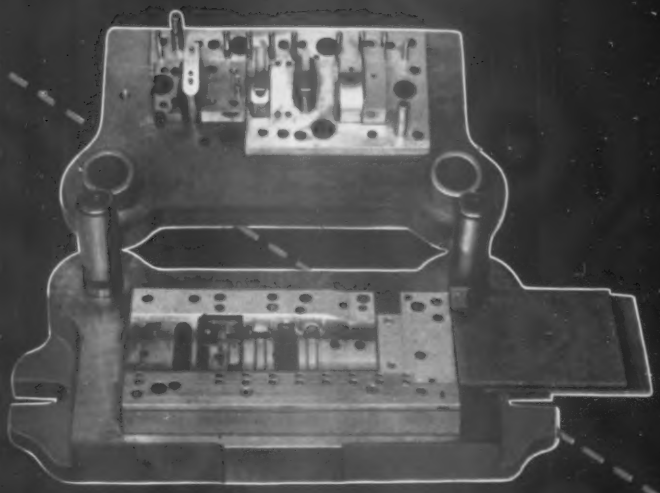


Photo courtesy of Federal Tool Corporation, Chicago

...using DANLY Precision Die Set

Save Time...

Use DANLY Nation-Wide Die Set Assembly Service

Assembly plants (marked with stars) stock interchangeable parts for quick assembly and delivery of any standard die set to your specifications.

- **Chicago 50,** 2100 S. 52nd Ave.
- **Cleveland 14,** 1550 E. 33rd St.
- **Dayton 2,** 990 E. Monument Ave.
- **Detroit 16,** 1549 Temple Ave.
- **Grand Rapids,** 113 Michigan Ave., N.W.
- **Long Island City 1,** 47-28 37th St.
- **Los Angeles 54,** Ducommun Metals & Supply Co., 4890 S. Alameda
- **Milwaukee 2,** 111 E. Wisconsin Ave.
- **Philadelphia 44,** 18 W. Chelten Ave.
- **Rochester 4,** 16 Commercial St.

Precision Guiding Required on Deep Blanking Tool

Here is another example of how Danly Precision Die Sets help maintain accurate punch and die relationship on high production work. The part illustrated, a slide cover, is produced at a rate of 120 pieces per minute on the 11-station progressive die and a Danly Standard Precision Semi-Steel Die Set.

An unusual deep blanking tool used in the last station requires precision guiding by the Danly Die Set to prevent breakdowns and assure peak performance. The blanking punch at this station enters the die a distance of 5/16".

Sequence of Operations

Brass coil stock, 3½" wide x .018" thick, is automatically fed through the following operations: Pierce pilot hole, slit, first form, idle, draw shape, pilot, restrike shape, pierce, idle, blank, pilot in scrap.

To date, over 3,000,000 pieces have been produced with the same Danly Die Set. An average of 200,000 pieces per grind is obtained.

Helpful Engineering Service — For helpful engineering service on die sets of any size, standard or special, for any type of press operation, consult Danly without obligation.

get this *free* bulletin

Illustrates how Danly special machining and welding facilities help you save time and money on special die set applications.

DANLY

DANLY MACHINE SPECIALTIES, INC.
2100 SOUTH 52ND AVENUE, CHICAGO 50, ILLINOIS

25 YEARS OF DEPENDABLE SERVICE TO THE STAMPING INDUSTRY

PRECISION DIE SETS...STANDARD AND SPECIAL ● MECHANICAL PRESSES AND PRESS EQUIPMENT

Sunnen Honing

Cuts Costs - Reduces Rejects

Eliminates Bell-mouth, Taper and Out-of-Round Holes

The Sunnen Precision Honing Machine produces a straight round hole in any size from .120" to 2.625" in diameter. Extremely smooth internal finishes can be held to a tolerance of .0001", if required.

This low-cost versatile machine duplicates sizes quickly and accurately — saves set-up time because there is no chucking of parts; and mandrels can be changed from one size to another in less than one minute.

Sunnen Honing corrects heat-treat distortion, rapidly removes cut-off and cross-drill burrs and flash from machined and punched parts. Permits final sizing after hardening.

A complete line of abrasives is available to produce any degree of surface finish required—in steel, cast iron, bronze, aluminum, carbides, ceramics, plastic or glass.

Sunnen Honing provides real savings in long run production costs. Even greater savings are possible on job lots and small runs when frequent size changes are necessary.

Write for bulletin, or on request we'll send a honing engineer to your plant.

SUNNEN

TRADE MARK REG U.S. PAT OFF. - MARCA REGISTRADA

SUNNEN PRODUCTS COMPANY • 7949 Manchester Avenue, St. Louis 17, Missouri

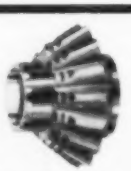
Canadian Factory: Chatham, Ontario

300

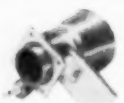
Typical Examples:

Automobile Distributor Shaft Gears. Taper removed at a rate of 80-90 per hour.

Hydraulic Two-Way Control Valve. Hole is honed to eliminate leakage.



Smooth surfaces provide long life for washing machine parts.



Miniature aircraft cylinder — smooth, accurate honing provides better compression and longer life.

Bell-mouth eliminated, production increased on these line reamer bushings.

Smooth finish and close tolerance easily held on 1⅛" hole in steel vibrator body.

the grinding job

Automotive crankshaft grinding on a Landis Tool 16" Type DH Hydraulic Crank Pin Grinder, rough and finish in one operation, direct from the lathe. SAE 1050 steel, Rockwell C 50-55. Stock removal .020" from each sidewall, .040" - .060" on O.D.

the wheel

Borolon vitrified, A466-N6-V12, 42" x 2¼"x 12" . . . unexcelled for this work. Superior grinding for quality finish . . . high production . . . ability to hold corners . . . consistently duplicated on every wheel re-order.

Borolon ALUMINUM OXIDE *Electrolon* SILICON CARBIDE

SIMONDS ABRASIVE CO.

PHILADELPHIA, PA.

Crankshaft Grinding Wheels

New . . . recently developed . . . Simonds Abrasive V12 Bond . . . exceptionally efficient for crankshaft grinding . . . proved by continuous use by many of the top crankshaft grinding accounts . . . also a standard in the regrinding trade.

Standard specifications:

Roughing	**A366-N6-V12**
Rough and Finish	**A466-N6-V12**
Finishing	**A60 -P5-V12**

where to get it

Simonds Abrasive Engineers working through Simonds Abrasive Distributors in all principal U. S. industrial centers have the experience and production "know how" to advise on grinding wheel selection for your specialized production. Complete details on request.

SIMONDS ABRASIVE CO.
Philadelphia, Pa.
Electric Furnace Plant, Simonds Canada Abrasive Co., Ltd., Arvida, P.Q.

SIMONDS ABRASIVE COMPANY
is a division of
SIMONDS SAW AND STEEL CO.
Fitchburg, Mass.
Saws, Machine Knives, Files

Other Divisions:

SIMONDS STEEL MILLS
Lockport, N. Y.
Special Steels

SIMONDS CANADA SAW CO. LTD.
Montreal, Can.
Simonds Products for Canada

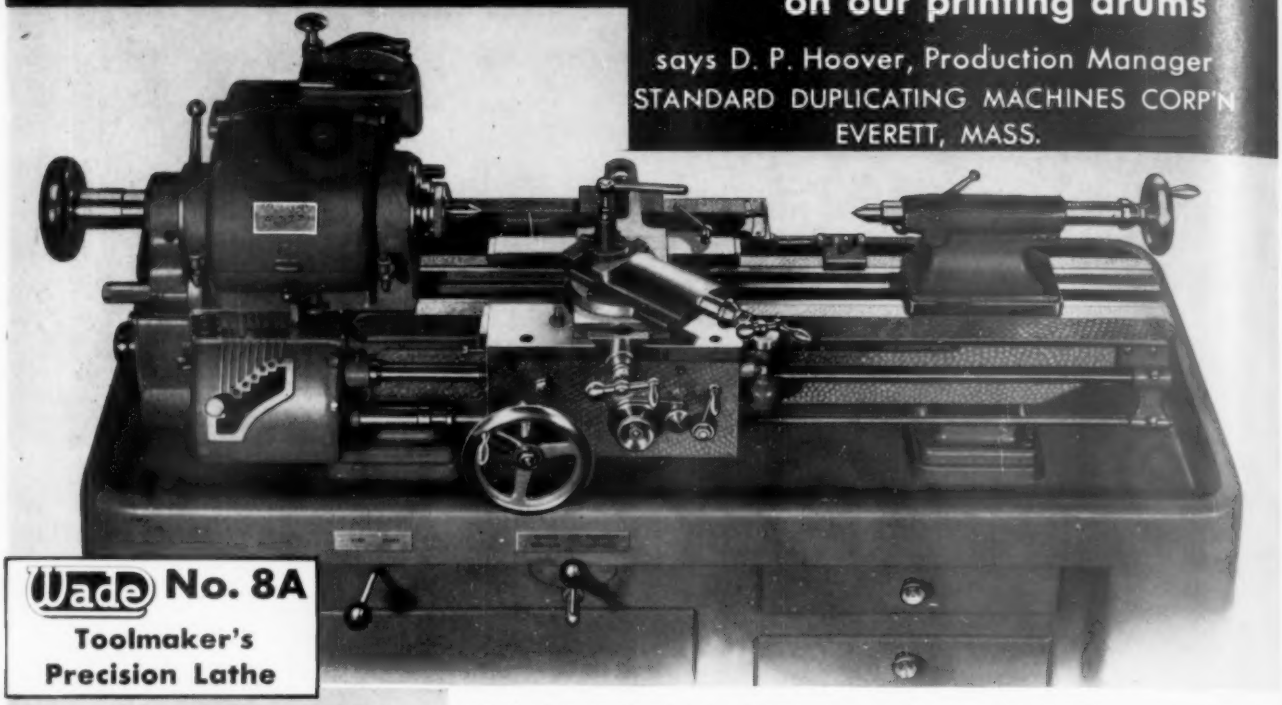
Quality control has characterized Simonds Abrasive Company products during more than 50 years as a major manufacturer of grinding wheels and abrasive products exclusively. This control begins with the abrasive grain produced in modern electric furnaces by Simonds Canada Abrasive Co., Ltd., and extends to the finished wheels for all types of grinding from roughing to precision finishing. This means consistently high wheel performance—long lasting action, that boosts production, cuts grinding costs.

SIMONDS ABRASIVE COMPANY, PHILADELPHIA 37, PENNA. • DISTRIBUTORS IN ALL PRINCIPAL CITIES

"Because it gives us

smooth finish and dimensional accuracy on our printing drums"

says D. P. Hoover, Production Manager
STANDARD DUPLICATING MACHINES CORP'N
EVERETT, MASS.



Wade No. 8A
Toolmaker's Precision Lathe

We had asked Mr. Hoover to tell us ***just why*** he preferred the Wade No. 8A Toolmaker's Precision Lathe for the finish operation on this drum. (He uses a less expensive, less accurate lathe of another make for roughing.) He told us that the 8A lathe has the ***speed*** and ***ruggedness*** he needs for high production output and a smooth surface, using tungsten carbide tools; and it has the ***precision*** that he demands for his final O.D., held to a tolerance of ± .002", and made possible through the rigidity of the spindle and the power of the drive.

One of the secrets of good printing reproduction on this low-priced fluid duplicator known as Model SWA is the great care used in casting and machining the zinc printing drum. This very efficient Standard Duplicator would fall far short of perfection with a poor drum, and we are proud that our No. 8A lathe is helping to maintain quality and speed up production at the Standard plant.

SPECIFICATIONS

Swing over Bed	8½"
Distance between Centers	24"
Collet Capacity	1"
Taper Standard for Centers	No. 2 Morse
Tailstock Spindle Travel	3¼"
Tool Shank Section	⅜" x ¾"

Write today for illustrated folder describing this very desirable Toolmaker's Lathe and its accessories

THE WADE TOOL CO., 59 RIVER ST., WALTHAM 54, MASS.

This is another example of how you can

WADE into your work with a Wade

Bethlehem Carbon Tool Steel

The most versatile grade

This unique sheet-metal punch, made by Rotex Punch Company of Oakland, Calif., provides a compact arrangement of punches and dies which are housed in revolving turrets so that the operator can make a quick selection of the punch he wishes to use. It accommodates 17 different punches and a shear blade, all made of Bethlehem XX Carbon Tool Steel.

Long tool life and keen cutting edges are provided for in the handy Rotex punch by the use of Bethlehem XX Carbon Tool Steel for all punches, dies, punch holders, and shear blades. This is a typical use where the basic advantages of carbon tool steel make it a logical selection.

CARBON—THE GENERAL-PURPOSE GRADE

Our carbon tool steels are the best choices for a wide range of tools and dies. Here's why:

★ They are the easiest to machine of all tool steels.
★ They have a hard case and a tough core.
★ They develop keen cutting edges.
★ They are easy to heat-treat.

Bethlehem X Carbon Tool Steel (0.75 to 0.85 pct carbon) is recommended for hand chisels and shock tools. XCL, XX, and XXX grades have several ranges of carbon content: 0.90 to 1.00 for cold-heading die steels; 1.00 to 1.10 for most tool and die work; 1.15 to 1.25 where extra-keen cutting edges and greater wear-resistance are needed for stone-dressing tools, paper-knives, drawing dies, etc.

CLOSE CONTROL OF HARDENABILITY

Easy machining and uniform results in heat-treating carbon tool steel are made possible by our close control of hardenability in the steelmaking process and uniform spheroidize-annealing. Bethlehem's extensive research has established the ideal degree of hardenability for a wide range of applications.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

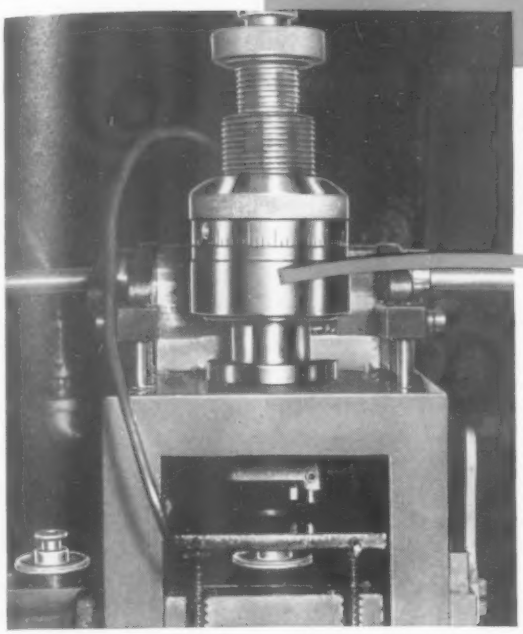
On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corp.

Export Distributor:
Bethlehem Steel Export Corporation

BETHLEHEM STEEL

CARBON . . . one of Bethlehem's Fine Tool Steels

GOT ANY DIFFICULT RECESSING JOBS?



Scully-Jones Standard Type "J" Automatic Recessing Tool with special circular form cutter; being used at Grigsby-Allison Co., Inc., Arlington Heights, Ill. on a small Delta Drill press, to cut external groove on a zinc die cast clutch gear, at a rate of 300 per hour.

Do Them Easily with SCULLY-JONES standard AUTOMATIC RECESSING TOOLS

(Three Types—Five Sizes)

You can do any of these with Scully-Jones Standard Automatic Recessing Tools: retainer ring grooves; reliefs for tapping, threading, grinding, honing; chamfers; second operations on cast or molded parts, or a combination of these operations.

DOWN go recessing costs —UP goes production

Scully-Jones Standard Type "J" Automatic Recessing Tool. Types "J" and "C" are designed to pilot in a fixture bushing and are used in drill presses and turning machinery.

Scully-Jones Standard Type "R" —size 2R Automatic Recessing Tool. Sizes 2R, 4R and 5R pilot in the hole or stop on the face of the work and are used in drill press, automatic screw machine or turret lathe operation, or in setups where it is impractical to mount a pilot bushing.

RESULTS THAT PAY

You get these results with Scully-Jones Recessing Tools:

1 Make many recesses with a single Recessing Tool, by merely changing tool bit holder or circular form cutter.

2 Operate on standard production machines—no costly special machines needed.

3 Maintain close tolerances—reduce rejects.

4 Get long life—low maintenance cost—as all parts are hardened and ground, and built to take severe punishment.

5 Speed up production—cuts costs, because tool operation is automatic.

Send For Details Today—No Obligation

Write on your company letterhead for a free copy of our new 28-page Manual No. 17-2. It gives you a clear picture of the application, operation, construction and many advantages gained by using Scully-Jones Automatic Recessing Tools.

Scully-Jones AND COMPANY

1915 S. ROCKWELL STREET, CHICAGO 8, ILLINOIS

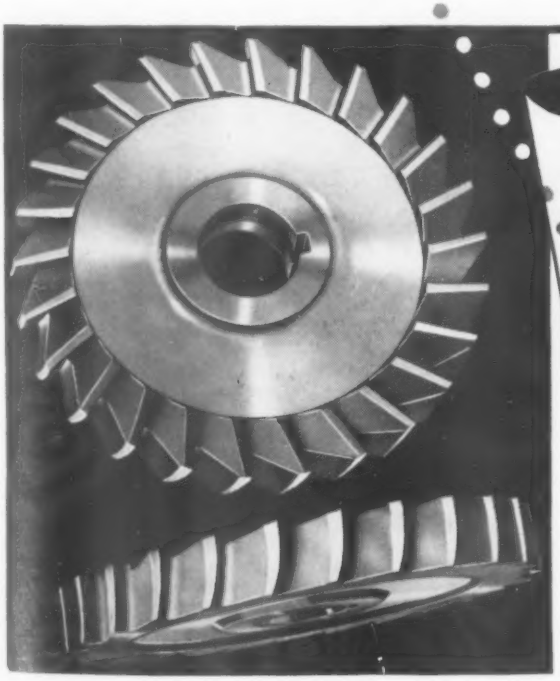
R-2759

YOU GET LOW COST, FAST, ACCURATE PRODUCTION WITH OUR STANDARD AND SPECIAL TOOLS

150 *to* 425

YES . . . in a recent comparative performance test, 150 Aber "Curved Tooth" milling cutters *out-performed* 425 conventional type milling cutters — a 2½ to 1 increase at NO EXTRA COST!

Designed and developed specifically for production men who look to NEW tool designs to reduce top-heavy metal cutting costs, Aber "Curved Tooth" milling cutters operate at speeds 10% to 25% faster than standard straight tooth milling cutters in addition to providing smoother finishes and close to tolerance operations. Utilizing the most outstanding tooth design developed in the past decade, Aber Engineering Company produces a complete line of quality milling cutters featuring the "Curved Tooth" principle.



A TYPICAL ABER "CURVED TOOTH" PERFORMANCE

OPERATION: Milling lugs on plate. Slotting and side milling parallel sides.

MACHINE: Cincinatti 3-Spindle Mill.

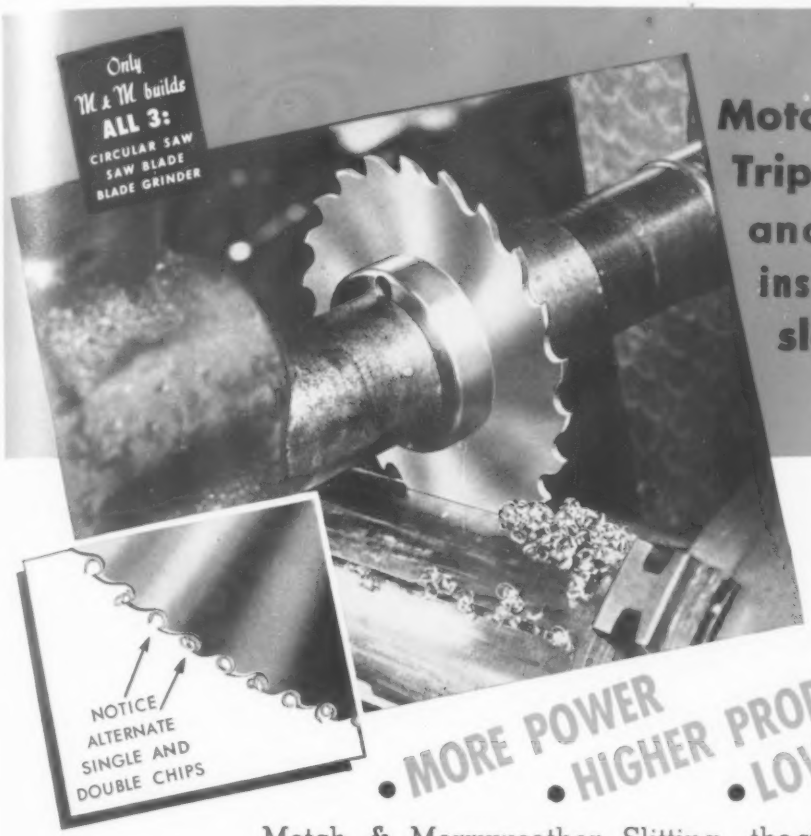
TOOL SETUP: (1) R. H. and L. H. Shear Side Milling Cutter.
(1) R. H. Half Side Milling Cutter.
(1) L. H. Half Side Milling Cutter.
Feed: 10-1 2"

PERFORMANCE: 16-1 2 hours between grinds. Best previous practice with conventional, straight tooth H. S. S. milling cutters was 6-1 2 hours between grinds.

KEEP UP TO DATE with tool design progress. Write today for more detailed information on the ABER line of "Curved Tooth" milling cutters.

ABER
ENGINEERING WORKS INC.
WATERFORD 2, WISCONSIN

More POWER to your Blades!

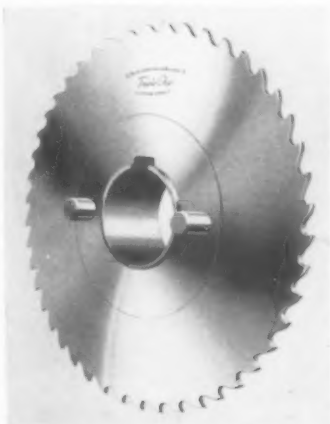


Motch & Merryweather Triple-Chip SLITTING SAWS and DUAL DRIVE ADAPTORS insure more profitable slotting production.

Triple-Chip METHOD

• MORE POWER • HIGHER PRODUCTION • LOWER COSTS • LESS BREAKAGE

Motch & Merryweather Slitting Saws have an exclusive dual drive feature through which balanced power is transmitted, eliminating the stresses which cause breakage. A broad, flat hub affords plenty of surface contact for rigid holding, which balks tooth weaving tendencies. Accurate slotting results. Our exclusive Triple-Chip tooth form breaks up and distributes the cutting load, permitting heavier feeds. Deep gullets increase blade strength and produce curling, self-ejecting chips (no clogging). You need fewer blades, since M. & M.'s exclusive adaptors fit many arbor sizes. Three standard tooth spacings in every diameter and thickness aid the cutting of thick or thin sections.



M. & M.'s exclusive dual drive delivers more power to the blade without danger to the driving means. Ample side clearance is ground into the blade down to the broad hub. Standard dual drive adaptors are designed with ample keyway to more than satisfy tough cutting requirements.

Write for our Bulletin "T-10"

SEE OUR EXHIBIT AT A. S. M. EXPOSITION, PHILADELPHIA, OCTOBER 25-29

THE MOTCH & MERRYWEATHER MACHINERY CO.
PENTON BUILDING • CLEVELAND 13, OHIO

CUTTING TOOL DIVISION

AT YOUR COMMAND • AN UNPARALLELED EXPERIENCE IN CIRCULAR SAWING

with NORTON *Vitrified Bonded* DIAMOND WHEELS

A fast cutting action *plus* long life — that's what you get with the Norton *Vitrified bonded* diamond wheel — that's why this patented Norton development will enable you to cut costs on many of your carbide tool and die grinding jobs.

For the offhand grinding of single point tools, for the grinding of chip breakers (wheels 1/4" and wider), and for many internal, cylindrical and surfacing jobs you'll find that Norton Vitrified diamond wheels can really cut costs.

Why? Because the vitrified type of bond, used so widely in other Norton wheels, gives a diamond wheel with these outstanding features: (1) a rigidity that gives dimensional accuracy to the work being ground, (2) a porous structure to promote faster and cooler cutting and (3) positive adhesion between the vitrified bond and the diamond grains which insure a long, useful wheel life.

The 138-page Norton handbook "Grinding Carbide Tools" is full of useful information. Write for a copy — no obligation.

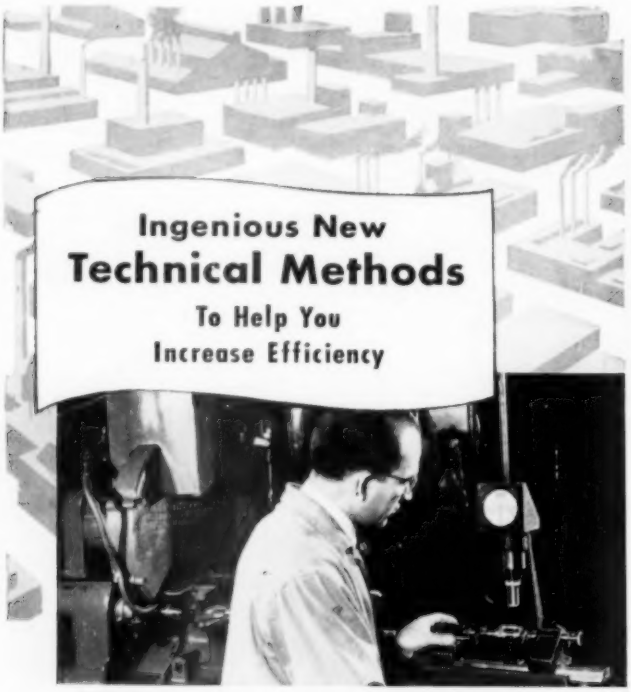
W-1191

Resinoid and Metal Bonds, too

Because Norton Diamond Wheels are available in all three types of bonds you can be sure of getting the most economical wheel for each carbide grinding job —and impartial assistance from your Norton abrasive engineer or distributor.

NORTON ABRASIVES

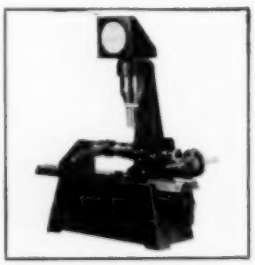
NORTON COMPANY, WORCESTER, MASS., New York, Chicago, Detroit, Cleveland, Philadelphia, Pittsburgh, Hartford, Denver, Los Angeles



Light Projector Increases Thread Grinding Production

Production of thread grinding machines can now be increased through the use of a light projecting device called the Thread Pick-up Projector. The thread profile appears in a viewing screen, magnified 20 times, thereby permitting accurate visual adjustments.

In operation the Thread Pick-up Projector is placed alongside the thread grinding machine. A Dalzen Thread Grinder, Model No. 1, is shown above. While the machine is grinding the thread, the operator, using the Light Pick-up Projector, adjusts a "dog" on the next piece to be ground. When the "dog" and piece are then placed in the thread grinder the thread profile is automatically in location, ready for grinding immediately.



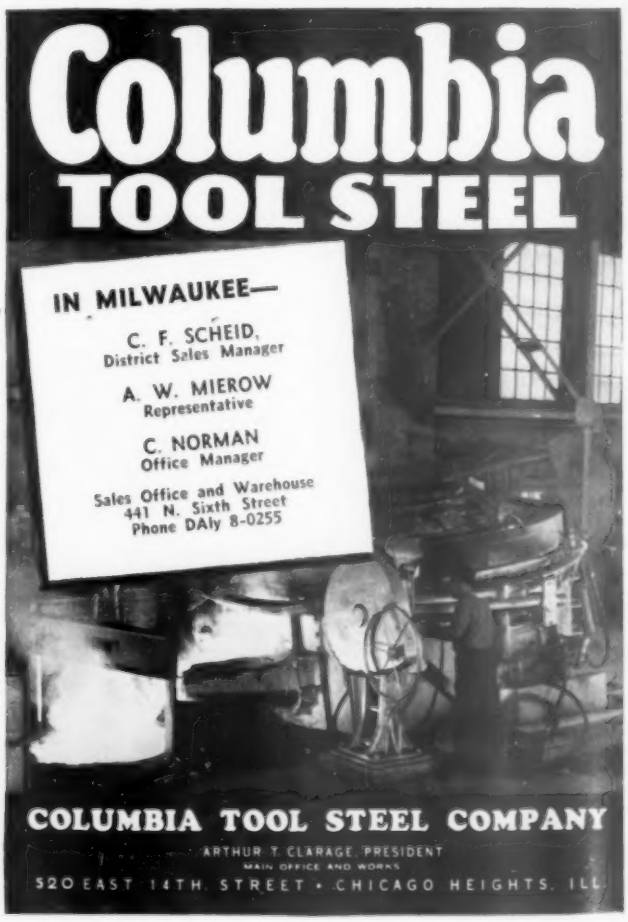
Thread Pick-up Projector

Even the most inexperienced personnel can "pick up the thread" using this instrument after only a few minutes demonstration. Grinding is also done more accurately and the viewer permits measurements of reliefs, notches, etc. to .0005 inch.

Efficiency of production can also be increased through the use of chewing gum. The act of chewing helps relieve nervous tension and seems to make the work go easier and faster. For these reasons, Wrigley's Spearmint Chewing Gum is being made available more and more by plant owners everywhere.

Complete details may be obtained from
Acme Scientific Company
1457 West Randolph, Chicago 7, Illinois

AC-77



carbide: dual adjustable milling cutters

Back of the success of O K carbide milling cutters is the fundamental basic design — two components, body and blades. The *wedge-shaped blade with mating serrations is a combination lock that holds blades fast, straight and true under the heaviest cuts. No screws, pins, gibs or other locking devices are required!

**The wedge is the world's simplest and strongest basic mechanical device.*

Made in two types: Inside type provides the major blade adjustment (4:1) on the periphery; Outside type on the face (1:4). This patented feature gives maximum blade life, the strength and rigidity of solid tools. These cutters take full advantage of the power built into modern machines for milling with carbides. Production tests prove they are the most trouble-free cutters on the market. Write for new catalog 13.

OK milling cutters

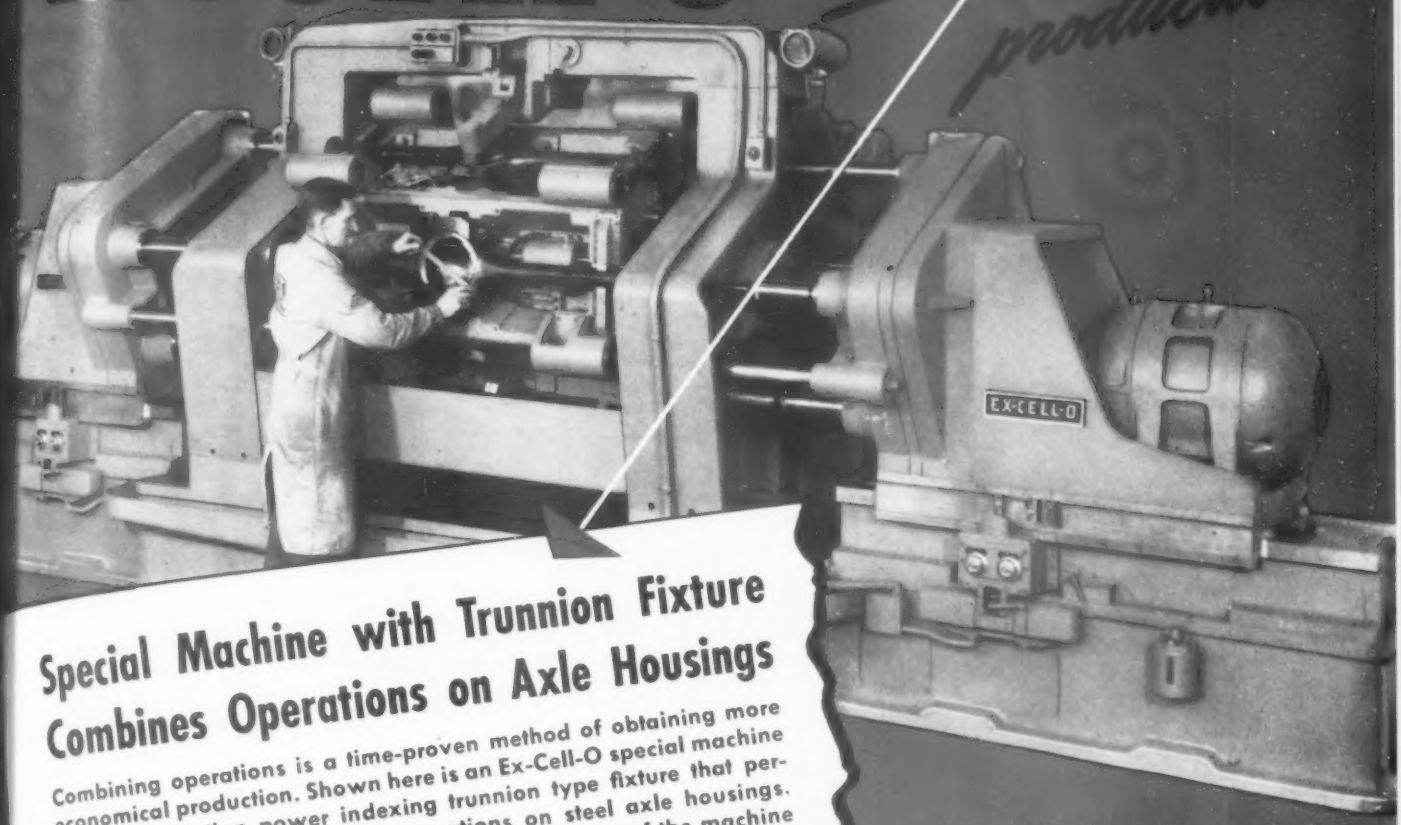
The O K Tool Company, Inc., Shelton, Conn.

Index of Tool Engineer Advertisers

October, 1948

EX-CELL-O

Can give you more economical production



Special Machine with Trunnion Fixture Combines Operations on Axle Housings

Combining operations is a time-proven method of obtaining more economical production. Shown here is an Ex-Cell-O special machine with a six-station power indexing trunnion type fixture that performs roughing and finishing operations on steel axle housings. Standard hydraulically-actuated slides at both ends of the machine carry multiple spindle heads and their drive motors. Another slide at the rear supports a precision spindle and a facing head.

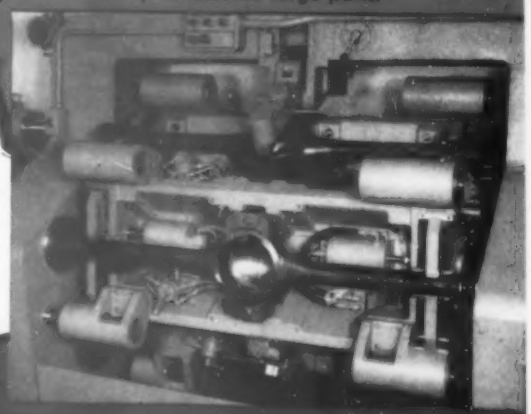
The tool holders in both the multiple spindle heads are rigidly guided by bushings in the fixture end frames. Coolant is manifolded to each station and directed through drilled holes to the point of contact between the tools and the work.

Parts are laid in the loading station and are located and clamped hydraulically. Operations are rough, semi-finish bore and ream bearing diameters at both ends; rough and finish face flanges, chamfer inside and outside edges of flanges and turn O.D. of flanges at both ends; face banjo. All these operations are performed at a net production rate of 55 pieces per hour!

Let Ex-Cell-O help you combine operations for more economical production. A complete staff of experienced machine tool engineers is ready to help you with your production problems. Contact your Ex-Cell-O representative today!

Above: Ex-Cell-O special machine performs many operations on steel rear axle housings.

Below: Close-up view of the Ex-Cell-O six-station trunnion type fixture which easily handles the large parts.



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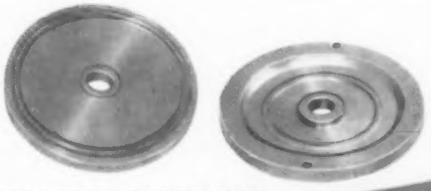
Underwood tackles HIGH BREAK-EVEN POINT

The Underwood Corporation of Hartford, Conn. is completing a far-sighted program to eliminate production inefficiencies in the manufacture of their world famous typewriters and business machines. Obsolete equipment is being replaced by fully automatic machine tools.

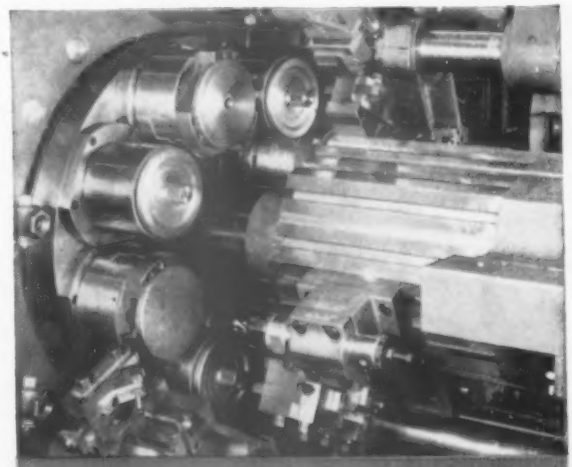
ON THIS PART



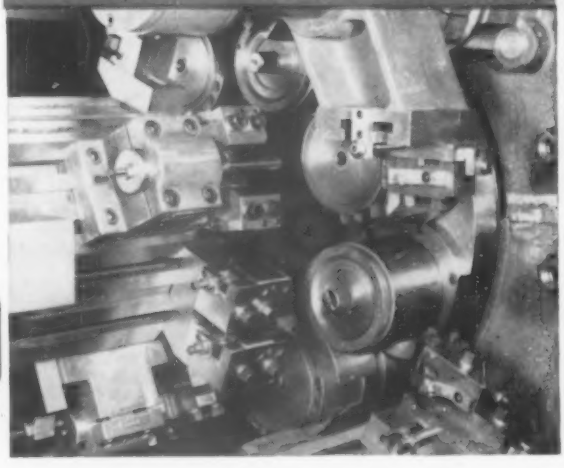
The production of the important type bar segment, illustrated, is an example of this sensible approach to profits. It was formerly machined by six operators on four turret lathes, two engine lathes and one special grooving machine. These seven machines and six operators were replaced by one New Britain Model 88 Automatic Chucking Machine.

* RESULT

- Production increased from 90 to 120 pieces per hour
- Labor costs reduced 85%
- Quality of part greatly improved with tolerances held under 0.001"



The operations are finishing the O.D., facing both contoured sides, machining the I.D. of the hub, and trepanning wire grooves in one face. Simultaneous completion of both sides was made possible by arranging the machine for double index.



Are YOU Missing The Boat?

You can't afford to overlook the possibilities of lowering your break-even point in a similar manner. The parts you are now producing in your plant may well be produced cheaper and better on a New Britain Automatic.

The parts described in our new *Cost History* file were money-losers until New Britain engineering turned them into money-makers. Let us send you your free copy.

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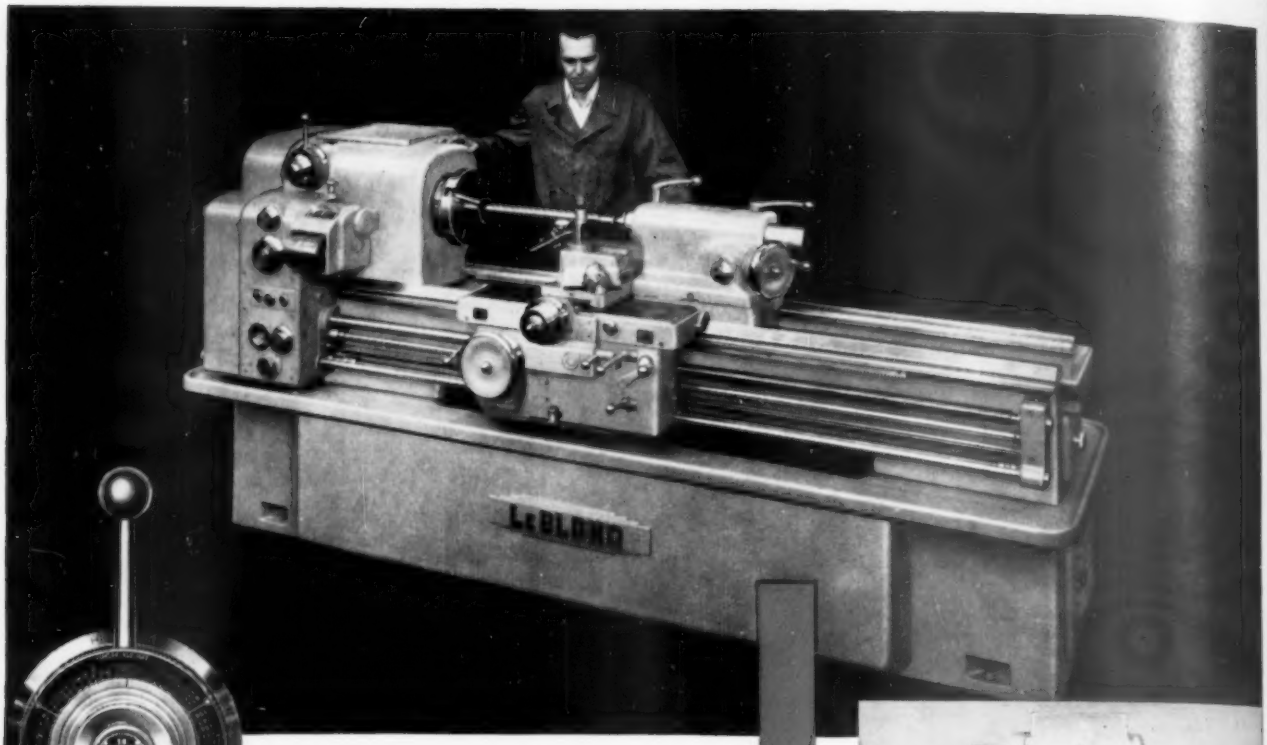


Shift over 300 speeds with this lever on the new 16" LeBlond Model RT Tool Room lathe

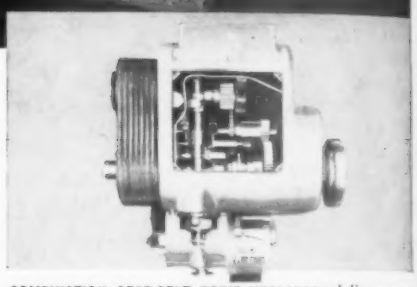
Never before have so many important new advantages been built into one tool room lathe as on the new 16" LeBlond Model RT. With the variable voltage headstock you can shift over 100 speeds in each of three ranges without stopping the spindle. With the universal quick change box you select from the greatest range of threads, leads and feeds.

The 4-directional power rapid traverse moves carriage, cross slide, and tailstock electrically. One-piece apron with single lever length and cross feed control . . . thrust-lock tailstock with spindle travel dial . . . automatic lubrication throughout headstock, feed box, and apron . . . and many other advantages are included as standard.

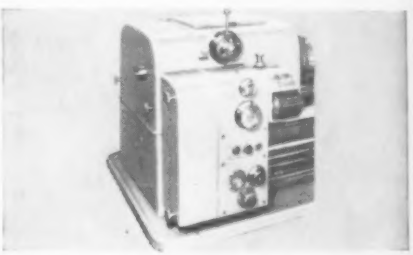
There's a place in every modern plant for the new Model RT, the production tool room lathe. Maybe there ought to be one in yours?

send for

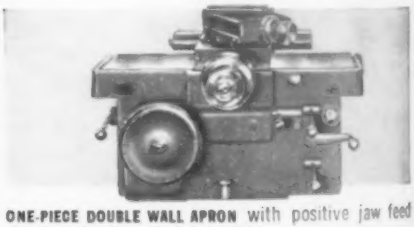
your free copy of Bulletin RT-31.



COMBINATION GEAR-BELT DRIVE HEADSTOCK delivers over 300 spindle speeds all shifted by a single lever.



UNIVERSAL QUICK CHANGE BOX offers widest possible range of threads, leads and feeds.



ONE-PIECE DOUBLE WALL APRON with positive jaw feed clutch and automatic lubrication.

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